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Synopsis of
OCCUPATIONAL
AND
ENVIRONMENTAL
HEALTH

C. N. Obionu
Synopsis of OCCUPATIONAL AND ENVIRONMENTAL HEALTH
Synopsis of OCCUPATIONAL AND ENVIRONMENTAL HEALTH

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ENUGU.
Dedicated to my entire family.
CONTENTS

Dedication 8i
Preface viii

Chapter

1. **Organisation of Occupational Health Services**
   - Early development 1
   - Scope of occupational health 2
   - Factors influencing the organisation of occupational health service 4
   - Functions of an occupational health service 5

2. **Hazards of Occupational Environment and General Methods of Controlling Occupational Hazards**
   - Routes of entry of occupational hazards 10
   - General methods of control of occupational hazards and occupational diseases 11

3. **Occupational Diseases Caused by Physical Hazards**
   - Diseases caused by ionising radiation 15
   - Diseases caused by ultra violet radiation 18
   - Diseases caused by noise 18
   - Diseases caused by vibration 19
   - Diseases caused by abnormal atmospheric pressure 20
   - Diseases caused by extreme temperatures 20

4. **Occupational Diseases Caused by Chemical Hazards**
   - Lead poisoning 24
   - Mercury poisoning 24
   - Poisonous gases 26
   - Dusts 27
   - Pesticides 28
   - Insecticides 28
   - Herbicides 29

5. **Occupational Diseases Caused by Biological Hazards**
   - Tuberculosis 30
Brucellosis
Leprosy
Anthrax
Tetanus
Rabies
Serum hepatitis (Hepatitis B)
Voodworm disease
Schistosomiasis
Snake bite

6. Some Specific Occupational Diseases
Occupational diseases of the lungs
Occupational asthma
Pneumococcosis
Silicosis
Coal workers pneumoconiosis
Asbestosis
Byssinosis
Bagassosis
Farmer’s lung
Bird fancier’s lung
Occupational diseases of the skin
Occupational cancer
Occupational diseases of agricultural workers
Occupational diseases of miners

7. Industrial Accidents
Determinants of accidents
Prevention of accidents

8. Rehabilitation
Diseases, impairment and disability
Types of disability
Degree of disability
The process of rehabilitation
Staff involved in rehabilitation
Industrial rehabilitation
Resettlement
Factors affecting the success of rehabilitation

9. Industrial Legislation
   Workman’s compensation decree
   Factories act
   References

10. The Human Environment
    Environmental health

11. Water Supply
    Characteristics of water
    Requirement of water
    Sources of water
    Protection of wells
    Water-related diseases
    Treatment of water

12. Sewage Disposal
    Methods of sewage disposal
    Sewage treatment
    Diseases associated with inadequate sewage disposal

13. Refuse or Solid Waste Disposal
    Diseases associated with refuse disposal
    Refuse disposal methods
    Recycling of wastes
    Problems of waste management

14. Housing
    Qualities of a good house
    Health hazards associated with bad housing
    Building regulations and bye-laws
    Building plans

15. Food Hygiene
    Food poisoning
16. Vector Control
   - Vector control methods
   - Insecticides in current use
   - Methods of application
   - Insecticide poisoning

17. Air Pollution
   - Sources of air pollution
   - Health effects of air pollution
   - Control of air pollution
   - Greenhouse effect and Ozone layer

18. Public Health Legislation
   - Medical officer of health
   - Health officer
   - Nuisances
   - Infectious diseases
   - Inspection of food exposed for sale
   - Bye-laws
   - References
   - Index
The welfare of mankind cannot be achieved without a healthy environment. Most of the diseases of mankind, be it communicable or non-communicable, are closely related to man's environment both at home and at work. A clean environment, if not exactly next to godliness, has at least a close kinship to public health.

Many in the health field do appreciate this fact but find it difficult to understand the reciprocal relationship between man and his total and occupational environment. It is from this understanding or approach, the so-called ecological approach to preventive medicine, that one can derive a rational basis for the control of diseases within the community.

This book attempts to describe the basic concepts of Environmental and Occupational Health, particularly as they concern the developing countries. The book which contains a total of eighteen short chapters is a modest attempt to produce a concise text book in these two areas of public health. Intended primarily for undergraduate (but also general practitioners and public health physicians in training), it is hoped that the book will help to enlighten the reader on the important and closely related areas.

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C. N. Obionu.
ORGANISATION OF OCCUPATIONAL HEALTH SERVICE

EARLY DEVELOPMENT

Provision of health at work is an important aspect of public health. The first observations relating to occupational health were on the relationship between the diseases of miners and their work made by Georgius Agricola (1494 - 1555) in a treatise on metal mining published in 1556, and by Paracelsus (1493 - 1541) on his monograph on occupational diseases of mine and smelter workers published eleven years later in 1567. Agricola's observations were based on his experience as official town physician to Joachinshatal, a mining centre in Boehettia, a former kingdom, now part of Czechoslovakia, while Paracelsus based his monograph on his experience as physician and later a metallurgist in metal mine in Austria.

In 1713, Bernardino Ramazzini (1633 - 1714), an Italian physician published the first systematic study on the influence that work may have on health. He emphasized the importance of questioning the patient about his occupation as this information may have an "utmost weight" on the management of the patient. He wrote what was the first textbook on the subject titled De Moribus Artificum Diatriba and was therefore rightly acclaimed the father of occupational medicine.

Industrialisation, during the 19th century, brought overcrowding, insanitary conditions of living and disruption of family life due to men leaving their families behind to move into new industrial areas. Women and children were subjected to long and strenuous working hours under adverse conditions. Epidemic diseases were rife. The Factory Act (1833) in England ushered the appointment of Factory Inspectors and also the “Act to regulate the Labour of Children and Young Persons in Mills and Factories”. In 1896, Sir Thomas Morison Legge was appointed first Medical Factory Inspector, or Occupational Health Consultant as it is known in Africa. He introduced in 1899 the idea of notifying occupational diseases, especially lead poisoning. He stressed a number of preventive aspects known as Legge’s Aphorisms. These aphorisms include:

1. “Unless and until the employer has done everything – and everything means a good deal – the workman can do next to nothing to protect himself, although he is naturally willing enough to do his share”.

2. “If you can bring some influence to bear external to the workman – that is one over which he has no control, you will be successful, and if you cannot, or do not, you can never be wholly successful”.

3. “Practically all industrial lead poisoning is due to the inhalation of dust and fumes, and if you stop their inhalation you will stop the poisoning”.

4. “All workman should be told something of the danger of the material with which they come into contact, and not be left to find it out themselves – some times at the cost of their lives”.

The 20th century saw some of the worst abuses and conditions of work put aright, and also some bacteriological discoveries, e.g. by Koch, Pasteur and others, which helped in the control of some infectious diseases. Few specific drugs and insecticides were available and tuberculosis and typhus still ravaged industrial cities. The second world war (1939 – 1945) led to much research on blood transfusion, antibiotics, etc. Dichloro-diphenyl-trichloroethane (DDT) was first used against typhus, and mepacrine and chloroquine replaced quinine as antimalarials. Much research was done in air
workers heat stressed in ships in the tropics and mines, and nutrition studies in prisons and refugee camps. In 1944, the Disabled Persons Employment Act was passed to cope with war injured. The act introduced quota of disabled for all factories. In the same vein, many European countries introduced legislations in occupational health. In Nigeria, the development of occupational health took a gradual process. The first indigenous occupational health service was by the Nigerian Railway Corporation in 1899, followed by the Nigeria Coal Corporation in 1909. Other establishments such as the United African Company (UAC) and John Holt set up more occupational health services, and later, the Shell BP Petroleum Company and other oil companies.

Rehabilitation centres such as Igbobi was started in Nigeria and in 1955 the Nigeria Factory Act was enacted (see detail in chapter Nine).

The United Nation in 1948 took in the International Labour Organisation - ILO (first formed in 1919). Since then several other influences have widened the scope of occupational health and stimulated interest in its practice, especially in industrialised countries.

SCOPE OF OCCUPATIONAL HEALTH

Occupational health as it is known today consists of two sub-disciplines, viz: occupational medicine and occupational hygiene. Occupational medicine deals mainly with people and with the two-way interaction between work and health. Occupational hygiene is concerned with measuring, evaluating and controlling of physical and chemical hazards in work places and includes ergonomics which is described as the science concerned with adapting machines and their controls to the mental and physical attributes of man.

Like other disciplines in public health, occupational health is essentially preventive. Although the role of occupational health service is the same for every working community, the type of services provided depends on the type of industry and on the needs and resources available. An occupational health service should be organised to meet the special needs of the industry concerned and the
type of population employed. For instance in developing countries, where a high prevalence of communicable diseases constitutes major cause of morbidity and wastage of manpower, the function of an occupational health service should include treatment and prevention of these diseases in the working community.

FACTORS INFLUENCING THE ORGANISATION OF OCCUPATIONAL HEALTH SERVICE

(a) Type of Health Services Existing in the Area
In developing countries where health services are insufficient or inadequate, the occupational health service in addition to dealing with the basic health problems of workers, may also consider to extend its services to the families and relatives of workers and sometimes even to the general public.

(b) The Size and Type of Industry
The size of an occupational health service and the number of staff required for the service will vary depending on the size of the work force and the severity of the potential hazards and associated risks. As a rough guide, one nurse, preferably with occupational health training, can be appointed to deal with somewhere between 500 and 2,000 work people, and where resources are available, she may need the help of a part-time doctor for advice and consultation. A full-time doctor assisted by a nurse can be expected to deal with the occupational health problem of about 2,000 - 7,000 work people.

Where lack of finance imposes a major problem on the provision of a separate service for the workers, especially for smaller units or firms, such places can engage the service of an already established occupational health service of a larger industry or retain the service of private practitioners (Retainership service). Alternatively firms within the same industrial neighbourhood can arrange for a group occupational health service.
An occupational health service in an industry where ignorance and illiteracy are rife among its workers will have a major responsibility of training and educating its workers about the specific hazards existing in the work place. This is because workers that are unfamiliar with industrial processes are more exposed to occupational injuries and hazards. Thus their occupational health services should emphasize health education.

FUNCTIONS OF AN OCCUPATIONAL HEALTH SERVICE

The objective of an occupational health service is to provide healthy and safe working conditions and help the workers maintain highest level of physical, mental and social well-being. To be able to achieve this objective, an occupational health service will have the following functions:

1. Placing People in Suitable Jobs

This is important in order to match individual capacity with suitable job, as some jobs demand some specific physical and mental requirements. Thus for example, a person that has just recovered from a heart attack cannot be considered fit to drive a public or company vehicle on a tight schedule in heavy traffic, or a person with chronic respiratory disease cannot be fit for a dusty occupation. In order to place the right person in the right job, examinations of applicants for employment are carried out and advice to their placement given (pre-employment or preplacement medical examination). The type of examination to be performed will depend on the job to be carried out by the worker, the requirements for the job and the hazards associated with it.

Periodic medical examination is carried out to detect whether the work has had any adverse effect upon the worker's health. Like the pre-employment medical examination the type of examinations to be performed and the frequency for such examinations depends on the hazard.
Post sickness absence examination is sometimes required of persons returning to work after a long period of absence due to illness or accident in order to give advice on suitable job.

2. Identifying Occupational Hazards

Recognition of hazards will lead to their control and will be more successful if a high index of suspicion is maintained. This is because every work environment contains some kind of health hazards. Such hazards can be identified by:

(a) Observation of the environment or environmental monitoring which can be done using some basic instruments or gadgets designed to measure environmental contaminants;

(b) Observation of work people who may give the first indication that a hazard exists through complaints, high level of sickness absence or unusual illness;

(c) Epidemiologic studies comparing records of illness and deaths in the work place with the expected figures in the general population.

3. Health Education

This should lay emphasis on education of work people in the hazards of the job and what measures to prevent the effect of such hazards. In addition health education should be given on general health matters and personal hygiene. Health education on the hazards of the job is the best protection that workers can be given, especially if one is dealing with ignorant workers or workers that are unfamiliar with industrial processes. The service should also educate the management on its responsibilities for the health of employees.

4. Screening for Early Evidence of Diseases

This is done to recognise early or latent stage of a disease in order to take early and necessary action against the development of the condition. Screening is done for occupational and non-occupation diseases provided the resources are available and that the disease meets the laid down criteria for screening. Viz: is an important health
5. Provision of Treatment Services

Provision of initial treatment for injuries and illness of sudden onset will help prevent people from going off work too often. Provision of treatment services by an occupational health service is very important in developing countries where the national health service is often inadequate.

6. Immunisation

Immunisation should be made available for workers at their workplaces, especially in developing countries and during mass immunisation. Specific immunisation must also be provided for workers depending on the risks involved in their jobs, e.g. tetanus toxoid to farmers, anthrax antigen to cattle rearers and hide and skin workers, etc.

7. Counselling

This ranges from simple advice to workers on specific complaints to more extensive counselling about personal, social, emotional, economic or other domestic problems. In these matters however, an occupational health service operates under strict confidentiality as dictated by ethics and by law.

8. Rehabilitation

Rehabilitation is aimed at restoring the patient to his fullest physical, mental and social capability. It starts immediately after the injury or disease and is achieved through the use of drugs, exercises, physiotherapy, speech therapy, provision of aids, etc. It is also the
responsibility of an occupational health service to ensure that a disabled worker is properly resettled in a suitable job.

9. **Record keeping**
   This is a very important activity of an occupational health service. The records must be simple, accurate and up-to-date and the information should be analysed from time to time to enable important decisions to be taken.

10. **Controlling Occupational Hazards (See (2) above)**
    This is one of the most important functions of an occupational health service. The type of preventive measures to be adopted will depend on the nature of the hazard and its route of entry. The general methods used for the control of occupational hazards are discussed in a separate chapter. An occupational health service should also see that pollution arising from work place does not adversely affect the work people or the neighbouring communities.

11. **Provision of General Health Advice to Management**
    This includes advice on conditions at work which many influence health, e.g. catering facilities, nurseries and sanitary amenities.
Health hazards of occupational environment or occupational hazards can be classified as follows:

(a) **Physical Hazards**
These are hazards caused by physical agents. Physical agents are defined as entities with minimal matter yet capable of affecting the biological mechanism of an exposed worker. Examples of physical hazards are radiation, noise, temperature, pressure, vibration and light.

(b) **Chemical Hazards**
These are hazards arising from chemical substances used in industries. They can be organic or inorganic substances and can be in form of liquid, dusts, fumes, vapours, mists or gas. Examples of chemical hazards are lead (organic and inorganic), pesticides, asbestos, silica, coal dust, etc.

(c) **Biological Hazards**
These are hazards caused by living organisms and include acute and chronic infections caused by viruses, bacteria, fungi and helminths, as well as toxic and allergic reactions to plant and animal agents. They also include bites by venomous animals and insects.

(d) **Mechanical Hazards**
They consist of hazards arising from accidents, e.g. injuries from tools and machines which as a result of their shape or force may cause some damage to parts of the body. Workers who habitually kneel at their work may suffer from beat diseases of the hand, elbow
or knee - a form of cellulitis or bursitis resulting from constant bruising of the tissue.

(e) Social or Psychosocial Hazards

These are hazards related to organisation in the work place, e.g. the worker's relationship with his fellow workers, or with the management. Such relationship has a lot of influence on the individual worker's morale, job satisfaction and general well-being and health. The hazards, depending on their severity, duration or the individual worker's capacity to adapt, may result in a variety of psychological or emotional disorders or negative behaviour and attitude to work.

ROUTES OF ENTRY OF OCCUPATIONAL HAZARDS

Apart from social hazard, every occupational hazard must gain entry into the worker's body or be in contact with it before it can produce some pathology. In order of importance, the main routes of entry are:

(a) Inhalation

Breathing in vapor, gas, mist, spray, fumes or dust is the commonest route of entry of occupational substances into the body. The substances are absorbed through the lung tissue. The large gas-tissue interface of an adult lung together with its rich blood capillary network makes alveolar absorption of many substances into the bloodstream rapid. The fate of any inhaled particles depends on their size. Only particles of about 5 microns and less in diameter will reach the alveoli while the larger and heavier particles will fall somewhere by the way side in the air passage and eventually be exhaled.

(b) Skin Contact

Contact with the skin is the major route of entry for certain substances particularly solvents. Upon contact with the skin, the substances can react with the skin surface and cause primary

10
irritation or penetrate the skin and cause skin sensitisation or enter the bloodstream and lead to systemic poisoning.

(c) Ingestion
This route of entry is common in home poisoning but may occasionally occur at work either accidentally or through eating or smoking with contaminated hands.

(d) Injection
This is also an unusual route of entry in a work situation except for parenteral transmission of viral organisms, e.g. hepatitis and AIDS which are quite common in health and laboratory workers.

GENERAL METHODS OF CONTROL OF OCCUPATIONAL HAZARDS AND OCCUPATIONAL DISEASES

Occupational diseases have been defined as diseases arising out of or in the course of one’s employment. Occupational diseases can be caused by physical, chemical, biological or mechanical hazards. Various methods are used for controlling occupational hazards and the diseases caused by them, but the methods to be used will depend on the type of hazard. The various methods used are listed below in their order of preference.

1. Substitution
This is the elimination of a toxic substance and substitution with a less harmful or non-toxic substance. It is also known as elimination by substitution and is the most effective method of controlling occupational hazards, although it is not always easy to find an appropriate substitute for some toxic substances used in industries.

There are few examples where substitution has successfully been used to control occupational hazards and the diseases caused by them. The substitution of yellow phosphorus with phosphorus sesquisulphide in the production of matches has led to the disappearance of phossy jaw in workers in matches industries. Other examples are the substitution of benzene with xylene and toluene as industrial solvents, and the substitution of methyl bromide with freon as a refrigerant.
Sometimes the process or the machine itself may need to be modified or redesigned to eliminate physical hazard such as noise or radiation.

2. Enclosure
This is to ensure that the worker does not come in contact with the toxic materials. By this method the process could be totally enclosed and automatic operation applied to reduce the risk of exposure to workers. Similarly, the worker could be shielded in an enclosure against physical agents such as shielding against ionizing radiation.

3. Segregation or Isolation of Harmful Process
This is the isolation of the harmful process from the remainder of the plant, thereby limiting exposure to only a small specified group of workers. This special or selected group of workers are well trained and equipped against the hazards. The areas where the particular harmful substance or process is kept are isolated from the rest of the work place to minimise hazard. Segregation is less efficient than total enclosure but has the advantage of making organisation and supervision of prevention easy.

4. Local Exhaust Ventilation
Locally applied exhaust ventilation is used to remove dust, vapours and fumes at source, especially when the toxic materials arise from point sources of release. If the exhaust entry is placed at close distance to the source of contaminant, most contaminants will be exhausted before becoming dispersed, provided that the velocity induced by the local exhaust exceeds the dispersion velocity at source of the contaminant. The velocity of air which is needed to extract the harmful substances must be adequate in order to extract the substances before they enter the general atmosphere.

5. General Ventilation
Natural ventilation, that is, ventilation produced without the aid of induced draft can be used to control low concentration of toxic
substances. The method can be achieved by provision of good windows and doors and moving the air about the room so that enough dilution will be achieved of the toxic substance. For this to be effective, the quantity of substance to be controlled must not be too great, and the substance must be of low toxicity and its release without sudden peaks.

6. Wet Method or Suppression
This is used to suppress dust at source. Water is applied to wet the surface and so prevent dust from rising during coal or rock drilling or in dusty constructions.

7. Personal Protection
Use of personal protective devices is required to supplement other control methods and as second line of defence against extreme risks like radiation. Used alone, they are not always effective as they are open to abuse by workers who may find some of the devices irksome, uncomfortable or unpleasant. Some of the personal protective devices used in industries include dust masks, respirators, ear defenders, goggles, gloves and overalls.

8. Personal Hygiene
This will help to reduce absorption of harmful substances by the skin. The skin must be washed with soap and water after work and the overalls must be properly laundered. Washing facilities should be provided at convenient places to encourage personal hygiene. Use of barrier creams may offer little protection to the skin but they must be washed off at the end of work. Eating, smoking or drinking should be done at the appropriate places and away from working areas in which there are contaminants.

9. General Cleanliness
This is also called good housekeeping. By encouraging tidiness in the work place, exposure to hazards can be reduced. Risks of accident and other hazards can be greatly reduced if it is clean and tidy.
10. **Limitation of Time of Exposure**

This will reduce the amount of hazard to which the worker is exposed and is used by radiation workers and workers exposed to other physical agents such as noise.

11. **Pre-employment Medical Examination**

This will eliminate people who, as a result of their physical or mental conditions, are likely to be susceptible to particular hazards. For example, persons with history of liver or lung disease should not be employed in a job that entails exposure to substances that are toxic or harmful to the liver or lungs.

12. **Health Education, Warnings and Publicity**

These will help to increase awareness of workers on the hazards in their work place and the measures to prevent them. Warnings and publications clearly displayed at strategic places will help to serve as reminders to the workers.
Chapter Three

OCCUPATIONAL DISEASES CAUSED BY PHYSICAL HAZARDS

DISEASES CAUSED BY IONISING RADIATION

Ionising radiation is probably the most dangerous of all occupational hazards. There are different types of ionising radiation and they include the following:

(i) Alpha particles

These are corpuscular radiation and can penetrate human tissues only to a depth of one-tenth of a millimetre. Irradiation is therefore confined to the immediate vicinity of the source of radiation, and substances which produce alpha particles are not very dangerous outside the body but very dangerous when inhaled or swallowed.

(ii) Beta Rays

Beta particles are also corpuscular radiation with a power of penetration greater than alpha particles but mainly effect the skin unless inhaled or swallowed.

(iii) Neutrons

Neutrons are corpuscular radiation with a wide range of energy and power of penetration.

(iv) X-rays

X-rays are electromagnetic radiation. They are usually produced artificially and can penetrate up to 15-30cm in tissue.

(v) Gamma rays

Gamma rays are electromagnetic radiation and can penetrate up to 50cm in tissue. The potency of radiation is measured in three ways:
(a) Roentgen: This is the unit of exposure. It is the amount of radiation absorbed in air at a given point, e.g. number of ions produced in 1 ml of air.

(b) Rad (Radiation absorbed dose) or Gray: This is the amount of radio-active energy absorbed per gram of tissue of any material, i.e. the unit dose absorbed. 1 Gray = 100 rad.

(c) Rem (Radiation equivalent man or Roentgen equivalent for man): This is used to compare doses of radiation which come from different types of sources but which produce equivalent amount of damage. It is the product of absorbed dose and the modifying factor.

Sources of Radiation

The following occupations are at greatest risk of exposure to ionising radiation:

(a) Workers in uranium mines;
(b) Nuclear reactor operators;
(c) Industrial radiographers;
(c) Radiologists and scientists using radio-active materials for research;
(e) Cathode ray and X-ray tube makers;
(f) High-voltage TV makers.

Other sources, not occupational exposures, include nuclear radioactive fall-out, atomic bomb explosion (e.g. Hiroshima and Nagasaki bomb explosions) and miscellaneous from television sets, radioactive dial watches, luminous markers and cosmic rays from natural environment.

Exposure to radiation occurs in two ways - externally and internally. External exposure occurs from sources localised outside the body and the effect depends on the penetrating power of the radiation. Whereas the external part of the body absorbs most of the radiation of low penetrating power (e.g. alpha and beta radiation), the highly penetrating radiation reaches the deep seated tissues and organs where it causes some damage. Internal exposure is caused by
radioactive substances that entered the body through inhalation (e.g. radioactive dust, gases or vapours) or through ingestion of contaminated food or water.

Health Effects of Ionising Radiation

The absorption of radioactive energy by the tissues leads to adverse biological effects. The effects of radiation may be somatic or genetic. Somatic effects develop directly in the irradiated individual and can be immediate or delayed, while genetic effects appear in the progeny of the person exposed to radiation.

Immediate or Acute effects

These include radiation sickness characterised by nausea, vomiting and fatigue and the so-called acute radiation syndrome characterised by cell damage and death of tissues exposed to very high dose of radiation. Exposure to higher doses, e.g. one Gray of penetrating radiation may lead to haematological changes due to suppression of bone marrow. Haemorrhage and anaemia are also common.

Chronic Effects

These include chronic dermatitis and cataract.

Delayed Effects

Cancers of various organs - skin cancer, bone tumours, (leukaemia) and lung cancers as well as sterility, embryopathy and malformations have all been associated with ionising radiation.

Genetic Effects

These are due to chromosomal mutations resulting in genetic effects on the progeny, e.g. abnormalities in later generations. Generally speaking, growing and dividing cells are more susceptible to damage by radiation than cells which are relatively inactive. Thus blood forming tissues in bone marrow and the reproductive cells in the testes and ovaries are very sensitive to radiation while muscles and bone itself are insensitive.
Preventive Measures

(i) Shielding or complete enclosure of radiation sources with materials that absorb radiation, e.g. lead.

(ii) Maintenance of safe distance between worker and the source of radiation.

(iii) Personal protection, e.g. wearing of lead shields and lead rubber aprons and gloves by radiation workers.

(iv) Reducing exposure time by workers.

(v) Environmental monitoring, e.g. use of film badge or dosimeter which gives an indication on the dose of radiation to which the worker has been exposed.

(vi) Good personal hygiene to avoid external contamination.

2. DISEASES CAUSED BY ULTRA VIOLET RADIATION

Exposure to ultra-violet radiation occurs in arc welders and persons who work often in sunlight, e.g. farmers and sailors. Health effects include conjunctivitis, the so-called welder's flash or arc eye, sunburn (erythema) and senile keratoses.

Coal tar and other chemicals may react with skin and make it more sensitive to ultra violet radiation causing an exaggerated form of sunburn, often with blistering.

Preventive Measures

(i) Eye protection with goggles or spectacles which filter ultra violet light.

(ii) Those working in sunlight should be provided with hats, face visors and protective creams for the skin.

3. DISEASES CAUSED BY NOISE

Noise is generally defined as any unwanted sound. Noise intensity is measured in decibels (dB). A prolonged exposure to loud noise of over 90dB can lead to hearing damage. Occasionally, damage to the ear can be caused by very intense noise, such as gunfire or explosion, leading to rupture of the ear drum and immediate deafness.
However, hearing damage resulting from industrial noise is generally of a slow, insidious nature, occurring over a period of years. Occupations that carry a particularly high risk of noise hazards include mining, tunneling, quarrying (deteriorations, drilling), textile machine operators of powerful combustion engines (jet engines, trucks, construction vehicles) and operators of heavy engineering machines.

Health Effects

Health effects of noise include inner ear hearing loss which may present initially as difficulty in hearing whispers and later deteriorates to a more apparent impairment. If further exposure is not stopped, the condition may worsen and lead to deafness – noise induced deafness. Noise induced deafness, once it occurs is permanent and cannot be reversed, even after withdrawal from exposure. The impairment or hearing loss caused by occupational noise is often bilateral and more or less symmetrical, but may be sometimes unilateral. Other effects of noise include the psychological ones of annoyance, irritation, loss of concentration, fatigue and stress leading to increased risk of accidents.

Preventive Measures

(i) Engineering controls to reduce noise at source by enclosure of noise sources, or design of plants, equipment and buildings to reduce noise.
(ii) Limitation of time of exposure.
(iii) Use personal protective devices e.g. well-fitting ear muffs, ear plugs or individually-made ear moulds.
(iv) Regular hearing test using an audiometer (audiometry), so that smallest deterioration can be detected earlier and the worker removed from further exposure and damage.

4. DISEASES CAUSED BY VIBRATION

Vibration may be transmitted to the entire body (whole-body vibration) or only to a part of the body (localised vibration), depending on the operation being carried out.
Drivers of tractors and other heavy equipment who are exposed to whole body vibration may suffer from pains on different parts of the body or giddiness or disturbed vision if the skull resonates at high frequency leading to vibration of the eyes.

In industries, vibrations are more common and are experienced by those using vibrating tools such as power saws, pneumatic drills and hammers, and other power tools, widely used in forestry, mining and construction industries.

Health effects of vibration include a condition known as vibration-induced white finger (VWF) or simply white finger, or dead hand. The disease is clinically indistinguishable from Raynaud’s phenomenon which is caused by a localised spasm of the arteries of the fingers. It is characterised by one or more fingers turning white with numbness and sometimes pain – usually some period after exposure to vibration. With more exposure to vibration, all fingers of both hands can be affected from finger tips to base. Prolonged exposure, perhaps 10 or 15 years to vibration may lead to permanent damage of the hands.

Preventive Measures
(i) Improving the design of vibrating tools to reduce vibration, hand tools, for example, should be fitted with special vibration-absorbing handles.
(ii) Personal protection, e.g. use of “anti-vibration” gloves.
(iii) Shortening of exposure time.
(iv) Preplacement medical examination to discourage those that are particularly vulnerable from undue exposure to vibration. Such persons include those whose fingers go white on exposure to cold and who are said to have “constitutional cold fingers”.

5. DISEASES CAUSED BY ABNORMAL ATMOSPHERIC PRESSURE
Changes in atmospheric pressure can lead to adverse health effects. Low atmospheric pressures are met in flying and work in high altitudes, but its effects are not common as aircraft cabins are pressurised. The commonest effect of altitude is lack of oxygen
which can lead to black-out or to behaviour changes. This can be prevented by wearing oxygen masks at high altitudes (above 10,000 ft) in non-pressurised environments.

High Pressure
High atmospheric pressures or hyperbaric conditions are experienced by those who work in compressed air, e.g. in tunnelling, in diving and in caissons, where high pressures are maintained to prevent water from entering the working area.

Health Effects
Working in a hyperbaric environment will increase amount of air that is dissolved in the blood and body fluids. The drop or reduction in pressure during decompression releases the gas from the solution just as when a soda water bottle is opened. The gas bubbles so released in the body fluids consist almost entirely of nitrogen since the oxygen is used up in the body. Too rapid decompression results in excessive formation of gas (nitrogen) bubbles in the tissue and the occurrence of decompression or caisson's sickness, commonly known as "the bends". The condition may develop within a few hours after decompression and is characterised by dull pain in the muscles, joints, bones and other parts of the body (Type I bends) or more serious symptoms like loss of vision, unconsciousness, dizziness, paralysis and death (Type II bends). If the nitrogen bubbles block the small arteries supplying the bones, there may be aseptic necrosis of the bone.

Preventive Measures
(i) Decompression should be gradual and must not be speeded up.
(ii) Pre-employment and periodic medical examination of compressed air workers and divers to exclude the obese, the alcoholics and those suffering from chronic respiratory and cardiovascular diseases. No one with a cold or respiratory infection should be compressed or decompressed as this may lead to serious ear damage.
Any person with symptoms of decompression sickness should be recompressed without delay and a very slow decompression commenced watching carefully that the symptoms do not occur.

6. DISEASES CAUSED BY EXTREME TEMPERATURES

Heat and cold represent opposite extremes in temperature, but occupational health hazards due to extreme heat are a great deal more common than those due to cold.

Occupations that are exposed to extreme heat include workers in steelworks, foundries, glasswork, melting, bakeries, boilers and outdoor workers working in very hot climate.

Health effects of heat appear when individuals are exposed suddenly to heat loads at levels to which they are not acclimatised or at which adaptation is not possible. The diseases resulting from this include skin disorder in form of prickly heat or heat rash; a depletion of salt due to excessive loss of sweat leading to heat exhaustion and heat cramps; heat hyperpyrexia or heat exhaustion and heat stroke with temperature of over 40°C (104°F); and heat syncope due to circulatory collapse.

Preventive Measures

(i) Workers exposed to hot environmental conditions should be allowed time to acclimatise to such working conditions.

(ii) Working hours should be kept short.

(iii) Clothing should be loose and permeable. Specially ventilated and cooled protective clothing may be necessary.

(iv) Generous fluid and salt intake should be encouraged.

Cold

Workers exposed to cold conditions include cold store workers, refrigerated warehouse workers, divers and outdoor workers during cold weather.

The health effects of cold are frostbite, general hypothermia, vascular abnormalities - Raynaud's disease, acrocyanosis, thromboangiitis obliterans.

22
Preventive Measures

Prevention is by:

(i) Protective clothing (warm clothing).
(ii) Provision of warm rest-rooms where hot drinks and foods can be served.
(iii) Selection of fit persons.

Industrial experience has shown that those who are thin and droopy tend to be more sensitive to cold since they lack the insulation provided by subcutaneous fat.
Chapter Four

OCCUPATIONAL DISEASES CAUSED BY CHEMICAL HAZARDS

1. LEAD POISONING

Lead remains the single biggest cause of poisoning in industries. Also at home lead poisoning has occurred in children who nibble at or suck anything which may have a lead-based paint, e.g. toys or flaking lead paints in old houses. In such children poisoning can cause mental retardation and, later perhaps, kidney disease.

Inorganic lead is used as ingredients in paints and solder, as plates in storage batteries and accumulators, for coating metals against corrosion, for manufacture of different alloys and in ceramics as a glaze. Organic lead compounds (tetra-ethyl and tetramethyl lead) are used in petroleum industry as antiknock additives in gasoline and fuels.

Inorganic and organic lead have different metabolic pathways in the body and as a result the signs and symptoms of poisoning by each are quite different.

Inorganic Lead

A partial list of occupations in which exposure to inorganic lead may occur include lead-acid battery makers, battery chargers, painters, solderers, pottery workers in ceramic industries, plumbers, welders and foundry workers.

Routes of entry are ingestion of dust and inhalation of dust or fume. Toxic effects are manifested on the gastrointestinal, haematologic, nervous and renal systems. Early symptoms include colicky abdominal pain and decreased appetite, almost invariably accompanied by severe constipation. There is also a greyish pigmentation of the gums, the so called lead line.

Later findings include anemia, pallor and decreased hand grip strength (muscular weakness) due to paralysis of the peripheral
nerves, typically affecting the radial nerve, giving rise to "wrist drop". The involvement of the central nervous system, usually due to severe exposure, may lead to encephalopathy characterised by convulsion, coma and delirium. The kidney can also be damaged following severe exposure leading to loss of kidney function and renal failure.

Prevention is by use of personal protective devices, dust control measures, personal hygiene, as well as pre-employment medical examination to exclude those with neurological and renal disorders from exposure. Periodic medical examination should be carried out to monitor the haemoglobin level, blood lead level and other indicators of poisoning such as the urinary coproporphyrin and the alpha - taevulinic acid (ALA), both precursors of haem. If haemoglobin falls below 12 grams per 100 ml or if blood lead rises above 80 micrograms per 100 ml, the worker should be taken off work. He should be returned when the level returns to normal.

Treatment of inorganic lead poisoning is by chelation with BAL - British Anti-Lewisite (dimercaprol) or calcium EDTA (ethyldiaminetetraacetate).

Organic Lead
The risk of poisoning with organic lead is generally limited to those who manufacture or work in petroleum industry and the storage tank cleaners. The compound responsible for most cases of poisoning is tetraethyl lead, an oily liquid which is easily absorbed from the skin and some times from the lungs.

Mild degrees of intoxication cause insomnia, headache, anxiety, irritability and minor gastrointestinal symptoms with metallic taste in the mouth. Severe cases will lead to encephalopathy (toxic psychosis) with delirium, manic and schizophrenic symptoms.

Methods of control are similar to those of inorganic lead.

2. MERCURY POISONING
The main hazard arises from occupational exposure to vapours of elemental mercury. Such exposures are encountered in mercury-ore mining, leather felting e.g. in hat industries, thermometer and
sphygmomanometer industries, amalgam makers, photographers and jewelers.

Acute poisoning by mercury produces irritation of the mucus membrane of the bronchus and the mouth leading to pneumonitis and swelling and bleeding of the gums.

Chronic poisoning will lead to the classical triad of erethism, tremor and stomatitis. Neurological and psychic symptoms are the most characteristic and include increased irritability, anxiety, tremor, depression, loss of memory and later speech defect.

Prevention of poisoning involves the application of the usual principles of control, as well as removal of affected workers from further exposure. Treatment is by chelation with BAL or penicillamine.

3. POISONOUS GASES

Some of the poisonous gases are used very extensively in the heavy chemical industries.

Ammonia is used in making fertilizers and as refrigerants in large cooling plants. Exposure will lead to irritation of the skin and mucus membrane of the eyes, corneal ulceration and blindness; irritation of the respiratory tract, pneumonitis and pulmonary oedema.

Carbon dioxide is used by fire extinguisher makers, firefighters for firefighting, brewers for aerating soft drinks and in form of "dry ice" as refrigerant. It is also abundant in mines (choke damps).

Exposure to a concentration of 3% in the air produces headache and dyspnoea while a concentration of 10% may lead to asphyxia and loss of consciousness.

Carbon monoxide is encountered occupationally by blast furnace workers, boiler room workers, coke oven workers, diesel engine operators, garage mechanics, arc welders, traffic personnel, fire fighters, etc.

Early symptoms of poisoning include headache, nausea, dizziness and later coma and death. Poisoning is caused by the binding of the haemoglobin in the blood with carbon monoxide to form carboxyhaemoglobin. Chronic exposure to levels beyond the...
Threshold limit value (TLV) of 50 parts per million will cause headache, memory defects, vertigo and signs of central and peripheral nervous system impairment (encephalopathy, neuropathy), and cardiovascular system disturbances.

Hydrogen sulphide is encountered in occupations like mining, brewery, chemical plants, tannery and sewage treatment plants. Exposure will lead to direct irritation of mucus membranes of the eye and respiratory tract, and haemorrhagic pulmonary oedema. Severe poisoning leads to coma, convulsion and death within a few seconds.

Chlorine is used in laundry work, bleaching, disinfectant making, and swimming pool maintenance. Exposure to chlorine of TLV of only 1 ppm will produce severe chemical pneumonia, tracheobronchitis and pulmonary oedema. Chlorine is a highly irritant gas.

Preventive Measures

Prevention of poisoning by gases is by use of respirators (gas masks) and closed-circuit devices. The worker should be removed from further exposure and in acute poisoning e.g. with carbon monoxide and carbon dioxide, immediate administration of oxygen can prevent serious damage. Good ventilation is also important.

4. DUSTS

Occupational diseases caused by dusts are discussed fully in chapter 6 under pneumoconiosis. They also include disease caused by the inhalation of dusts of inorganic mineral substances such as asbestos (asbestosis), silica (silicosis) and mixed coal dust (coal worker's pneumoconiosis).

Inhalation of asbestos dust, apart from causing asbestosis, can also cause lung cancer and mesothelioma - a malignant tumour of the pleura and peritoneum.
Iron oxide, although harmless on its own, can cause a benign form of pneumoconiosis (siderosis) seen for example in foundry workers, welders, and haematite miners. The same applies to stannosis due to inhalation of tin dust e.g. by tin miners.

5. PESTICIDES

Pests are living things (plants and animals) whose existence constitutes a nuisance or threat to man or man’s interest. Pesticides are chemical substances used for the elimination or control of pests and include insecticides for insect control and herbicides used in killing weeds.

(i) INSECTICIDES

Poisoning due to insecticides can be seen in farmers who use them to control agricultural pests that damage their crops and in vector control workers (mosquito scouts).

Poisoning occurs through inhalation, skin contact or ingestion and the health problems resulting therefrom vary according to the insecticides. The commonly used insecticides include chlorinated hydrocarbons e.g. DDT, dieldrin, endrine, aldrine, BHC; organophosphorus insecticides, e.g. parathion, malathion, abate; and carbamates, e.g. baygon, servin, etc.

(a) Chlorinated Hydrocarbons

Signs of acute poisoning by chlorinated hydrocarbons include convulsion and liver damage. Acute poisoning due to swallowing should be treated with emetics. Chronic poisoning due to continued intake of smaller quantities will lead to nervous symptoms, characterized by hyperexcitability, anxiety and tremors. In addition there is marked loss of appetite and weight loss.

Treatment is by large doses of phenobarbital for a period of time. In addition the person should be removed from risk of contact with the insecticide for a long period.
(b) Organophosphates

Symptoms of poisoning by organophosphorus insecticides are similar to those of chlorinated hydrocarbons but include also bronchial disturbances. Organophosphorus insecticides inhibit the vital enzyme systems of the body, cholinesterase, leading to symptoms due to accumulation of acetylcholine in the body. Such symptoms include headache, faintness, blurred vision, nausea, abdominal cramps, bronchospasm, excessive salivation, muscle twitching, convulsion and coma.

Treatment is by intravenous atropine and 2-pyridinium aldoxime methiodide (2-PAM-iodide). In severe cases artificial respiration may be necessary.

(c) Carbamates

Poisoning by carbamates gives rise to a more rapidly reversible cholinesterase inhibition complex. Treatment is by atropine only and recovery is usually quite rapid.

Preventive Measures

(i) Use of protective devices (overall, mask, helmet, gloves and goggles).

(ii) Personal hygiene - washing of the body with soap and water after spraying.

(iii) Health education.

(iv) Periodic monitoring of the blood for acetylcholinesterase level and removal of the worker from further exposure if there is any sign of poisoning.

(ii) HERBICIDES

Like insecticides herbicides are used by farmers but for eliminating unwanted grass or weeds. The two herbicides most commonly used, paraquat and disquat, if inhaled can lead to acute inflammatory and irreversible damage of the lung tissue and often death. Others, e.g. trichloracetic acid can produce dermatitis.

Preventive measures are similar to those used for insecticides.
Chapter Five

OCCUPATIONAL DISEASES CAUSED BY BIOLOGICAL HAZARDS

Biological hazards include acute and chronic infections by bacteria, viruses, rickettsia, chlamydia or fungi, as well as parasitism and toxic and allergic reactions caused by plant and animal agents. Many of the biological hazards are zoonoses and, consequently, agricultural or other workers associated with animals may be at risk. Laboratory and hospital workers may also be exposed to biological hazards.

1. TUBERCULOSIS

This is a chronic infectious disease caused by the organism Mycobacterium tuberculosis, an acid fast bacillus. Persons who are at greatest occupational risk are health professionals in hospitals and sanatorium caring for individuals afflicted with tuberculosis. Mode of transmission is by inhalation. The majority of the infections will lead to pulmonary tuberculosis characterised by fever, night sweats, weight loss and cough with expectoration and haemoptysis. Preventive measures include:

(a) Periodic tuberculin testing and BCG vaccination for those who test negative.
(b) Periodic chest x-ray of individuals involved in the care of tuberculosis patients.
(c) proper disposal/handling of sputum of patients, and the use of masks by health workers.

Bovine tuberculosis occurs when unpasteurised milk of infected cattle is ingested. This is more common in cattle rearers and nomads.

2. BRUCELLOSIS

This is a disease of cattle (Brucella abortus), goats (Brucella melitensis) and pigs (Brucella suis). It is transmissible to man through milk or by direct contact with discharges from the sick animal, and
given rise to an illness characterised by intermittent fever (undulant fever), severe muscle pains, weakness and headache. There may be generalised lymphadenopathy. Brucellosis is a chronic disease and may last for years.

The disease is common in animal farmers, veterinary surgeons, butchers and others who handle animals. Preventive measures include good hygienic practices and proper attention to minor cuts and scratches, especially on the hand and forearm of workers.

3. LEPTOSPIROSIS (Weil’s Disease)

This is a disease of rats and the causative organism, *Leptospira icterohaemorrhagiae*, a bacterium, is excreted in rats urine. It is a hazard in any place infested with rats, particularly if there is stagnant water in which the bacteria can live for weeks. Consequently, it is a particular risk for sewer workers and farmers who may contact the infection through a cut or scratch. The organism can also penetrate the intact skin or mucous membrane. It is characterised by fever, headache, muscle ache, jaundice and sometimes spontaneous bleeding. Prevention is by use of protective clothing by those who work around infested places and by rodent control.

4. ANTHRAX

This is a disease of horses, goats and sheep transmitted to man through contact with farm animals or with their furs, wool, hair, bristles, hides, skins and bones. The bacterium, *Bacillus anthracis* gains entrance through cuts or abrasion in the skin causing a painless ulceration (malignant pustule). Inhalation of anthrax spores can lead to very severe pneumonia.

Prevention is by sterilisation of imported animal products, immunisation of workers, use of protective devices and health education.

5. TETANUS

This is an acute disease caused by the toxins produced in the body by the *tetanus* bacillus, *Clostridium tetani*. The route of entry is
generally through cuts in the skin from penetrating or crush wounds contaminated by soil or manure. A disease mainly of farmers, the disease is characterised by tonic spasms mainly of the muscles of the mouth, neck and back.

Prevention is by active immunisation, using tetanus toxoid. Once the injury has occurred in a person with no prior immunisation, human immune globulin or antitoxin administered soon after the injury may serve as preventive measures. A thorough initial treatment of wounds, including local antibiotic treatment of wounds is recommended.

6. RABIES

Rabies is a viral disease of dogs, cats, wild animals and vampire bats. At special risk of rabies are veterinarians, wild animal handlers, cave explorers, farmers, ranchers, trappers and individuals involved with dogs and cats of unknown origin. The disease is transmitted to man by bites of rabid domestic or wild animals. The virus gains access into the body causing almost invariably a fatal acute encephalitis characterised by headache, anorexia, nausea, fever, exaggerated sympathetic responses and hydrophobia.

Prevention of rabies is by avoidance of animal bites and caves, labouring infected bats, post-exposure immunisation, and pre-exposure immunisation of domestic animals and of high-risk individuals.

7. SERUM HEPATITIS (Hepatitis B)

Health workers, especially surgeons and those in renal dialysis units are at risk of serum hepatitis. The disease is primarily limited to parenteral transmission. (Parenteral transmission of infectious hepatitis is rare, but also possible).

The disease is characterised by jaundice of varying degrees, anorexia, fever, generalised weakness and hepatomegally.

Prevention is by sterilisation of instruments, use of disposable instrument, and proper disposal of excreta, for infectious hepatitis. Prophylactic use of immune serum globulin given in the incubation period, will protect against clinical hepatitis in workers who have
had accidental contact with positive blood or excreta. Immunization against Hepatitis B virus is now practised for at-risk groups.

8. **HOOKWORM DISEASE**

This is a helminthic infection caused by the nematode worms, *Ancylostoma duodenale* and *Necator americanus*. Occupations at highest exposure to hookworm infection are bare foot farmers, ditch diggers, sewer workers and beach workers. Infective larvae enter the body through the unbroken skin. The disease is characterised by ground itch (erythema, oedema and pruritis), and later, non specific gastrointestinal symptoms. Chronic infection with hookworm can lead to iron-deficiency anaemia, especially in under-nourished individuals.

Prevention is by proper disposal of faeces, health education and wearing of shoes or rubber boots and gloves by farmers.

9. **SCHISTOSOMIASIS**

Schistosomiasis is due to an infestation of the human body by the blood flukes of which there are three major human types, namely, *Schistosoma haematobium*, *Schistosoma mansoni* and *Schistosoma japonicum*. The disease is common in tropical countries and individuals at risk of infection include fishermen, dock workers, farmers and others working in water or swampy areas. The larvae (cercaria), after maturation in suitable water snails penetrate the skin of man from where they migrate to various sites in the body where they mature and cause symptoms. The disease is characterised by haematuria in *S. haematobium* and gastrointestinal symptoms in *S. mansoni* and *S. japonicum*.

Prevention is by proper disposal of faeces, snail control, avoidance of human contact with infected water, mass treatment of infected cases and protective clothing (rubber foot wear, gloves etc).

10. **SNAKE BITE**

Snake bite is an occupational hazard of tropical outdoor workers, especially farmers, nomadic cattle rearers, hunters, forestry workers,
fire wood gatherers and others who work in the fields and bushes. Snake charmers are also at risk of snake bite.

In the tropics, mainly two types of snakes are incriminated, the viperids (vipers, adders) and the elapid (cobras, mambas). The viperids have long erectile fangs, triangular or spadeshaped heads and usually short fat bodies. The elapid have short fixed fangs and relatively long trunks.

Poisoning due to viper venom includes local swelling at site of bite, haemorrhages (haemoptysis, bleeding from mucous membranes) and in severe cases blisters and necrosis around the site of bite. Elapid poisoning has neurotoxic effects characterised by ptosis, glossopharyngeal palsy and respiratory distress due to the venom on nerves of the eye muscle and the muscles for swallowing and respiration.

Preventive measure is by use of protective device (rubber boots). Management of snake bite includes:

(i) First aid which is done by wiping the wound with clean cloth and applying a firm ligature or crepe bandage just above the wound. Tetanus toxoid is also given.

(ii) Treatment with effective specific anti snake venom (ASV). Where the specific ASV is not available, a polyvalent (broad spectrum) antivenom can be used.
Chapter Six

SOME SPECIFIC OCCUPATIONAL DISEASES

OCCUPATIONAL DISEASES OF THE LUNGS

The lung is a most important organ in occupational health. This is because it is both a route of entry and a target organ for toxic substances. Inhalation is by far the commonest route of entrance to the body of occupational agents. The substances may be in form of fumes, mists, vapours, gases or dusts arising from solid particles during crushing, detonation, impact or precipitation and drying. As a rule only dust particles measuring between 0.5-5 microns in diameter tend to reach the alveoli and bronchioles where they become deposited and cause some pathology. Larger particles are mainly deposited in the conducting system of the lungs.

The most important occupational diseases of the lungs include the occupational asthma and pneumoconiosis.

OCCUPATIONAL ASTHMA

This is caused by the inhalation of sensitising agents or irritants present in the working environment. Such substances can be irritant gases, mineral and organic dusts as well as materials of plant and animal origins.

Occupations at risk include grain and cereal workers, wood workers, sawmill operators, laboratory workers handling animals, workers in chemical and pharmaceutical industries, workers using platinum salts in electrophorotyping, printers using gum arabic, detergent enzyme manufacturers and manufacturers of polyurethane foams using isocyanates. Atopic persons are particularly susceptible.

The mechanism of occupational asthma is an abnormal immunological response (hypersensitivity reaction) to foreign materials which act as antigens. The substances cause disorders characterised by bronchoconstriction leading to acute airways obstruction, inflammation and oedema of the airways and mucus
excretion. Clinically, there is dyspnoea, chest tightness, wheezing, and impairment of pulmonary function not distinguishable from other types of asthma. The attack may be immediate (within a few minutes of exposure), and the patient recovers within about two hours after withdrawal from exposure, or delayed, when it may occur at night, many hours after the closure of the days works.

Preventive measures include:

(i) Good ventilation and control of the concentration of air pollutants.
(ii) Use of protective devices e.g. respirator, dust mask, etc.
(iii) Elimination by substitution of irritant and sensitising agents.
(iv) Pre-employment and periodic medical examination to exclude atopic individuals.

PNEUMOCONIOSIS

Pneumoconiosis is the accumulation of dust in the lungs and the non-neoplastic reaction to its presence. It is thus the name given to a group of lung diseases caused by dust.

The dust may be mineral or inorganic dust, e.g. in silicosis (silica dust), coal miner's pneumoconiosis (coal dust), asbestosis (asbestos fibre), or organic dust e.g. in byssinosis (cotton dust), bagassosis (sugar cane dust) and farmer's lung (mouldy hay).

SILICOSIS

Silicosis is an occupational disease caused by the inhalation of finely divided silicon dioxide (silica). Exposed to silica dust are people engaged in mining, quarrying, tunnelling, stone-setting, tile-making, glass manufacturing and any occupation working silica-containing rocks or sand.

Inhalation of silica dust leads to fibrosis of the lung. The disease is characterised by dyspnoea or breathlessness which gradually becomes marked as the condition progresses. There could be associated bronchitis and later emphysema and heart failure.

Silicotic patients are at increased risk of pulmonary tuberculosis and this is probably due to the damage caused by the dust to
macrophages and to the lymphatic and immune system which normally protect against tuberculosis.

Preventive measures include:

(i) Dust suppression (pre-wetting, wet drilling).
(ii) Use of protective devices (respirator, dust mask).
(iii) Adequate ventilation.
(iv) Pre-employment and periodic medical examinations to exclude those with or who develop pulmonary pathology, and
(v) Withdrawal from exposure of persons who develop the disease.

COAL WORKER'S PNEUMOCONIOSIS
(ANTHRACOSILICOSIS OR ANTHRACOSIS)

Coal worker's pneumoconiosis or anthracosilicosis is caused by exposure to mixed dust, containing small amounts of silica and coal (carbon).

All workers in deep mines, especially those involved in open-cast mines, workers in loading operations and those in industries using coal are at great risk of exposure.

Inhalation of coal dust leads to accumulation of dust, especially in the upper lobes of the lungs which may or may not affect longevity (Simple Coal Worker's pneumoconiosis). In a mixed dust pneumoconiosis the pathology depends to a large extent upon the relative proportion of free silica or quartz present in the dust. Dust containing large amount of silica leads to complicated coal worker's pneumoconiosis characterised by massive fibrosis of the lung with severe disability. The disease usually takes years to develop and in simple coal worker's pneumoconiosis there may be mild dyspnoea which regresses if the worker is withdrawn from exposure. In complicated coal worker's pneumoconiosis there is severe dyspnoea, shortness of breath, cough and signs of cardiac failure and the symptoms do not regress on withdrawal from exposure.

Preventive measures include:

(i) Dust suppression by wet drilling or spraying the coal face with water.
(ii) Improved ventilation.

37
(iii) Use of protective devices (respirator, dust mask).
(iv) Pre-employment medical examination to eliminate those with chest pathology and periodic medical examination to detect early changes.

Unlike silicosis and asbestosis coal worker's pneumoconiosis is not notifiable by the Factories Act of Nigeria.

Caplan Syndrome

This is an appearance of rounded nodules in the lungs of coal miners with rheumatoid arthritis resembling the nodule seen in rheumatoid arthritis. Typical Caplan nodules have recently been seen in other conditions suggesting that they are not specifically related to coal dust exposure.

ASBESTOSIS

Asbestosis is a pneumoconiosis caused by the inhalation of asbestos fibre used in industries. Asbestos is one of the most, if not the most widely used minerals in industries because of its properties of being tough, acid and fire resistant. All the three types of the mineral used in industries are dangerous to health, the most dangerous being blue asbestos (crocidolite), followed by brown asbestos (amosite) and finally by the white asbestos (chrysotile).

Asbestosis is common in persons engaged in asbestos mining, asbestos cement factories, ship building, dockyards and power stations during lagging and delagging, motor industries in grinding brake and clutch parts, building material industries manufacturing asbestos cement sheets, tiles, pipes, etc., heavy engineering and loco and railway carriage building (furnace heat and sound insulation), and transporters handling sacks and bails of asbestos.

The characteristic lesion of asbestosis is that of diffuse interstitial fibrosis of the lungs mainly in the lower lobes. Symptoms include progressive dyspnoea, cough with mucopurulent sputum, weight loss, cyanosis and finger clubbing. The heart is finally affected as in any chronic lung disease. Other asbestos-induced diseases include:
(a) Lung cancer (cancer of the bronchus).
(b) Mesothelioma of the pleura and peritoneum (a type of cancer affecting the pleural or the peritoneal lining).
(c) Cancer of the gastrointestinal tract and larynx.

About half the people who get asbestosis also get lung cancer or mesothelioma but because these two conditions require a smaller exposure, it is possible to get them without having asbestosis first.

Neighbourhood Asbestosis

There is evidence that the dust carried home by an asbestos worker on his clothing or overalls and the inhaled dust by those living down-wind in the neighbourhood from asbestos mine or factory, can in a small number of people, also lead to asbestosis and other asbestos-induced diseases.

BYSSINOSIS

This is a lung condition caused by the inhalation of dust of cotton, hemp or flax during the early stages of their processing. It is found in workers in cotton industries, especially those working in the cardroom (cardroom worker’s asthma) and in blowing and spinning processes.

It is not a typical pneumoconiosis since fibrosis as such does not occur. The condition is believed to be an allergic reaction to plant material leading to constriction of the bronchial tubes, similar to bronchial asthma. Symptoms are characterised by tightness in the chest on starting work on Monday morning or after a long holiday (Monday fever), and gradually on other days of the week. There is cough with or without sputum and dyspnoea on exertion indistinguishable from chronic bronchitis.

Prevention is by rigorous dust control or by steaming the raw cotton. Withdrawal from exposure will also prevent further damage to the lungs.

BAGASSOSIS

This is an allergic condition following the inhalation of dust of fungal spores (Thermoactinomyces vulgaris) contained in decaying sugar
cane fibres after the extraction of sugar water from the sugar cane stalk. The fibres are called bagasse and used for making boards. It is a disease of sugar cane workers and other workers exposed to bagasse.

The condition is not a true pneumoconiosis since fibrosis does not occur and like farmer’s lung, should be more properly classified as a biological hazard. Symptoms of bagassosis include fever, breathlessness and severe cough occurring a few weeks after exposure. Prevention is by wet methods of work to reduce dust inhalation, use of dust masks (respirators) and removal of individual from the offending environment.

**FARMER’S LUNG**

This is anextrinsic allergic alveolitis caused by breathing the dust of mouldy hay containing some fungal spores, *Micropolyspora faeni*. It is an allergic condition found in farm workers and farmers exposed to dust of hay and slilage.

The disease is characterised by fever, increasing breathlessness, wheezing, cough and expectoration indistinguishable from asthma. Pathological changes found after repeated attacks of farmer’s lung are those of an interstitial fibrosis.

Prevention is by environmental control (elimination of conditions conducive to fungal growth), proper ventilation and personal protection by use of respirators.

**BIRD FANCIER’S LUNG**

Bird fancier’s lung is an extrinsic allergic alveolitis caused by the inhalation of avian protein contained in dust from droppings of certain birds such as parrots, and pigeon (pigeon breeder's lung). The disease is common in bird handlers and is characterised by breathlessness, fever, cough and wheezing.

Prevention is by proper ventilation, cleanliness and personal protection. Bagassosis, farmer’s lung and bird fancier’s lung are forms of **Extrinsic Allergic Alveolitis or Hypersensitivity Pneumonitis**. They are caused by the inhalation of organic dusts and are characterised by a diffuse allergic reaction in the walls of the alveoli.
and bronchioles. The condition is to be suspected when a person regularly exposed to a heavy concentration of organic dust, shortly after re-exposure complains of general malaise, dry cough and dyspnoea.

OCCUPATIONAL DISEASES OF THE SKIN

Occupational skin diseases or occupational dermatosis result from contact of the skin with the causal agents. Causal agents can be physical, biological, mechanical or chemical.

Examples of physical agents are ultra-violet (UV) radiation, ionising radiation, heat, etc.

Biological agents, e.g. fungi, parasites, etc. can also cause skin diseases or infection. Mechanical agents include macro and microtrauma and friction as seen in manual labourers with thickened palms and corns.

Chemical agents are by far the commonest causes of occupational dermatosis. Chemical agents that can cause dermatosis are further subdivided into primary irritants, sensitizers, acnegenic agents and photosensitizers.

Primary Irritants

These are substances which, if allowed to come in contact with normal skin in sufficient quantity will lead to dermatitis at the area of contact. Primary irritant contact dermatitis is the most frequently encountered occupational dermatosis and it is characterised in the acute phase by erythema, oedema, papules, vesicles or bullae, localised often on the hands, forearm or face. The diagnosis can be confirmed with a skin patch test with the causal agent. Agents that cause primary irritant dermatitis include detergents, weak acids and alkalis, organic solvents etc. Chronic dermatitis is characterised by skin changes similar to allergic contact dermatitis or eczema and difficult to diagnose.

Sensitizers

These are substances which on repeated or prolonged contact may lead to allergic skin reaction. First contact with the substance does
not produce any skin changes but may produce sensitisation (allergy) which does not manifest until further contact with the sensitizer occurs, perhaps at a different site on the skin where an area of skin changes is produced.

Allergic contact dermatitis or eczema has the same clinical features with non-occupational eczema. The acute form resembles the acute irritant dermatitis and the chronic form is characterised by lichenification and fissuring. Patch tests with suspected substances can be helpful in diagnosing skin hypersensitivity. This is done by strapping the suspected allergens to the skin for 24-48 hours. Some of the chemicals that can act as sensitisers include chromium, nickel, cobalt, polyvinyl chloride, rubber chemicals, plasticizers, formalin, cement, etc.

Acnegenic Agents

These substances cause occupational acne characterized by plugged sebaceous follicles and suppurative lesions. Such substances include mineral oil, tar, pitch, bitumen and chlorinated aromatic compounds. The lesions may be localised at the site of contact (e.g. mineral oil, tar, pitch) or more generalised as in acne caused by chlorinated aromatic compounds.

Photosensitizers

These are substances which are capable of stimulating the skin to activity by light. Examples of such substances include tar, pitch, anthracene, acridine dyes, etc. Acute solar dermatitis is regarded as an occupational disease if it is largely promoted by photodynamic substances used in the occupation, e.g. tar and tar-derived products.

Occupation involving exposure to agents causing skin diseases include agricultural workers (air radiation, pesticides, animal food additives); construction workers (cement, paints, plastics); chemical production workers, electroplaters, and workers in engineering industries (cutting oils, lubricants), etc.

Preventive measures include elimination by substitution, protective clothing, use of barrier creams and personal cleanliness. Patients with irritant dermatitis and other acute non-allergic
affections should be temporarily removed from exposure, and should be allowed to return to their original job only after the causal agent has been controlled. Permanent removal is necessary in patients with allergic contact dermatitis, precancerous conditions, in serious cases of irritant dermatitis and when repeated transfers do not lead to complete recovery. Legislation against the use of certain chemicals known to cause dermatosis will also help to control the disease.

3. OCCUPATIONAL CANCER

The first recognised occupational cancer was described in 1775 by Percival Pott, a London surgeon, who linked a high prevalence of scrotal cancer in chimney sweepers to their occupational exposure to soot produced by coal burned in the chimneys they cleaned. Since then a multitude of chemicals have been recognised as carcinogens causing cancers in various organs. A list of some occupational cancers and their causative agents is given below, although it must be emphasised that the list is not exhaustive.

(i) Skin Cancer (primary epitheliomatous cancer)

Causes: substances containing polycyclic aromatic hydrocarbons: tar, pitch, mineral oils, crude paraffins, soot and bitumen which is less carcinogenic than tar. Also ionising radiation and arsenic.

Occupation at risk: Tar distillers, coal gas manufacturers, coke plant workers, briquette manufacturers, road builders (exposed to pitch and tar products), refinery workers, paper industry workers, munition workers, candle makers (exposed to crude paraffins), chimney sweepers (exposed to soot), ionising radiation workers and chemical plants and pesticide workers using arsenic.

Control: Substitution with non-carcinogenic materials; use of protective devices, personal hygiene, clean clothes, bathing and washing; health education on risks associated with materials.
(ii) Lung Cancer
Causative agents: asbestos, ionising radiation, uranium, arsenic.
Occupation at risk: asbestos workers (page 38), radiation workers (page 15), uranium miners, workers in arsenic refineries and arsenic pesticide manufacturers and users.
Control: Substitution, use of protective devices, environmental and personal hygienic measures and health education.

(iii) Liver Cancer (Hemangiosarcoma)
Causative agents: Vinyl chloride.
Occupation at risk: Workers manufacturing polyvinyl chloride (PVC), rubber makers and organic chemical synthesizers.
Control: Protective devices (respirator and gas mask) to prevent inhalation of vinyl chloride gas.

(iv) Blood (Leukaemia)
Causative agent: Benzene, ionising radiation.
Occupation at risk: Adhesive makers, glue makers, linoleum makers, rubber makers, detergent and dye makers using benzene; radiation workers.
Control: Protective clothing, gloves, and breathing apparatus. Personal hygiene, clean clothes, bathing, washing and changing benzene-wetted clothes. Control measures for ionising radiation.

(v) Cancer of the Nasal Sinus
Causative agent: Nickel, wood dust, especially hardwoods, leather dust.
Occupation at risk: Nickel refinery workers, wood workers, carpenters and leather workers.
Control: Personal protection, environmental measures (adequate ventilation and dust control), personal hygiene.

(vi) Bladder Cancer (Papilloma of the Bladder)
Bladder Cancer (Papilloma of the Bladder)

Causative agent: Beta-naphthalamine, benzidine.

Occupation at risk: Rubber and dyestuffs industries.

Control: Substitution, personal protection and personal hygiene.

4. OCCUPATIONAL DISEASES OF AGRICULTURAL WORKERS

The predominant occupation in developing countries is agriculture followed by small-scale industries, construction and mining.

Health problems of agricultural workers can be as a result of exposure to physical, chemical, biological, mechanical and social hazards.

Occupational diseases of agricultural workers can thus be classified according to the components of the work environment and include the following examples:

(i) Physical Hazard
Excessive heat (High temperature).
Ultraviolet radiation (from the sunlight).

(ii) Chemical Hazard
Insecticide poisoning.
Herbicide poisoning.

(iii) Biological Hazard
Farmers lung
Bird Fancier's lung
Tetanus
Brucellosis
Hookworm disease
Schistosomiasis
Snake bite.

(iv) Mechanical Hazard
Cuts by farming implements and machinery in mechanical farming. Fall from heights.
(v) **Social Hazard**  
Social hazards resulting from separation from home and lack of social amenities by migrant farmers.

**OCCUPATIONAL DISEASES OF COAL MINERS**

(i) **Physical Hazard**  
- Beat disease (beat knee, elbow, hand and tenosynovitis).
- Nystagmus (rapid oscillation of the eyeballs resulting from poor lighting).

(ii) **Chemical Hazard**  
- Coal workers pneumoconiosis.
- Bronchitis (although not recognised as occupational disease).

(iii) **Biological Hazard**  
- Ankylostomiasis (Hookworm disease)
- Dermatitis.
Chapter Seven

INDUSTRIAL ACCIDENTS

INTRODUCTION

Accidents are among the leading causes of death in developed and developing countries. An accident is defined as an unexpected, unplanned occurrence which may involve injury (ILO, 1971a). Others define accidents as unexpected and unpremeditated events causing damage to persons or properties. Those hazardous or dangerous occurrences which do not lead to damage or injury are described as "near-misses" and are also very relevant to prevention.

Accidents can be classified according to severity as fatal or non-fatal, or according to circumstances in which they occur as domestic, transport and industrial accidents. Rarely, there are also accidents occurring from recreational activities and falls in the street, which do not come under any of the above classical groups. Fatal accidents are those accidents that cause death. Accidents that do not lead to death of the victim are described as non-fatal. Non-fatal accidents can further be subdivided into minor, i.e. those requiring only first aid treatment or leading to loss of working time of less than one shift, and major i.e. those leading to hospital admission for at least one working shift.

Industrial Accidents

Industrial accidents are accidents arising out of and in course of employment. Industrial or work accidents constitute a major cause of sickness absence in industries. As industrialisation and mechanisation increase, work accidents become more frequent. Occupations such as building construction, agriculture and mining are more accident prone than others. Causes of accidents include handling goods, falling of objects or persons, strike against objects, transports and machinery.
Determinants of Accidents (Causal Factors)

Factors that influence the frequency of accidents in industries include:

(a) **Personal Factors**
- Ignorance: an illiterate worker can be ignorant because he cannot read and understand instructions and signs given on the machine with which he works.
- Training and Experience: lack of training and experience in the proper handling of machine can increase the frequency of accidents.
- Illhealth, Defects and Disabilities: accident hazards are increased by illness and disabilities (e.g. hearing or vision defects).
- Fatigue or Sleeplessness: precision and ability to respond promptly to stimuli can be reduced by fatigue or lack of sleep.
- Alcohol and Drugs: alcohol and drugs can lead to impaired attention and judgement.
- Age: younger workers are more prone than older experienced workers.

(b) **Environmental Factors**
- Lighting: poor lighting can lead to poor visibility and thus increase accidents.
- Temperature and Humidity: extremes of temperature and humidity can lead to discomfort and fatigue and thus contribute to increased rate of accidents.
- Untidy Work Place: wet and dirty floors can lead to falls.
- Noise: excessive noise can slow concentration and increase the tendency for error and accident.

(c) **Machinery**
- Bad design, e.g. lack of adequate safety design can lead to accidents.
- Mechanical failure and lack of maintenance of machinery can lead to accidents.
Prevention of Accidents

To be effective, accident prevention must seek to identify defects in human, environmental and operational (machine) aspects and take measures to remedy such defects.

Human Aspect

(i) Education of workers on the danger in the work process and how to avoid them.
(ii) Provision of training courses on safety for managers and supervisors.
(iii) Use of protective devices by workers.
(iv) Pre-employment and periodic medical examination of workers to identify undue medical risks for certain jobs.
(v) Posters and warning signs to continuously remind workers about safety measures.

Environmental Aspect

(i) Factory to be well lit and properly ventilated.
(ii) Floors to be kept dry and free from oil spillage and obstructions (good house-keeping).

Mechanical Aspects

(i) Application of ergonomic principles in the design of machines.
(ii) Initial and periodic inspection of machines by safety engineers to identify defects.
(iii) Proper maintenance and servicing of machines.
(iv) Guarding (protection) of all dangerous parts of the machine.

Legislation (See also Chapter 9)

Establishment of minimum standards of codes of practice and safety requirements and effective inspectorate to ensure implementation of rules and legislations.
Safety officers to be employed in the factory to give attention to all aspects of safety and ensure compliance with all safety regulations.

Reporting

Any accident which disables a person for 3-5 days must be reported and all accidents should be entered in the accident book to be kept in every factory.
Rehabilitation is the restoration of a handicapped individual to the fullest physical, mental, social and economic usefulness of which he is capable. Through rehabilitation, a handicapped or disabled person is made decreasingly dependent (or increasingly independent) on others for living, by developing to the greatest extent possible the abilities needed by him for adequate functioning in his individual situation.

The purpose of rehabilitation is to reduce as much as possible the degree of impairment in a person or in the disabled part of the body, help the person adjust to or compensate for any loss of function, and also prepare the person upon discharge to return to gainful employment and lead a normal life. It aims at achieving maximum activity in a disabled person.

Disease, Impairment and Disability

There is a difference between disability and the impairment that gives rise to it. A disease, injury or ill-health is a medical condition, and depending on the severity may give rise to impairment of bodily function. For instance, injury to an eye can give rise to impaired vision or loss in that eye. Impairment in this case is the loss of vision or diminished vision in that eye. If the impairment leads to inability or reduction in ability to undertake certain functions, it becomes a disability. Disability is described as a condition where impairment (physical, psychological or social) results in function loss. Disability thus exists when the impairment is of such severity that certain normal activities of daily living are affected, that is, when the impairment produces a handicap. If the condition or impairment is such that it in no way affects the individual’s normal activities, such a person is in a real sense not disabled.
Types of Disability

Disabilities are classified as primary disabilities if they are direct consequences of a disease condition, e.g. paraplegia or quadriplegia following spinal cord injury. Secondary disabilities are disabilities which did not exist at the onset of the primary disability but subsequently developed. They are indirectly related to the disease condition, e.g. joint contracture, disuse muscle atrophy etc.

Disabilities can be traumatic, i.e. resulting from accidents (e.g. traumatic paraplegia), congenital presenting at birth (e.g. congenital dislocation of the hip, CDH) or familial, i.e. inherited manifesting at birth, e.g. CDH or later in life, e.g. muscular dystrophy.

One can also differentiate between physical, mental and social disabilities depending on the functions affected.

Degree of Disability

Disabilities may be sub-divided into three categories according to their severity.

**Moderate:** Any anatomical or physiological impairment or loss of a stable nature that is still present after maximum rehabilitation has taken place, but which does not affect the individual's ability to lead a normal life.

**Severe:** Any gross anatomical or physiological impairment or loss still present after maximal rehabilitation has taken place, stable or unstable or progressive, which may affect the individual's ability to live a normal life and due to cumulative effect constitutes a state of disabled living.

**Very Severe:** Any gross disability involving impairment or loss, stable, unstable or progressive, that produces severe secondary clinical manifestation.

The Process of Rehabilitation

Rehabilitation should begin at the onset of the disease or injury and should not be left until the patient is considered fit for discharge from the hospital. The process of rehabilitation includes medical
examination and evaluation of disabilities of the handicapped patient, the prescription and supervision of therapy, including physical and occupational therapy, the training of the handicapped person in self care, as well as other medical supervision and coordination of other rehabilitation processes.

Rehabilitation of common disabilities can be conducted on an in-patient or out-patient basis, at a day hospital or a residential centre, depending on the facilities available and the local circumstances.

Apart from restoring adequate function after injury or illness (medical rehabilitation), rehabilitation is designed to enable the individual to resume his life in the family and community (social rehabilitation) and to restore fitness for work after injury or illness (industrial rehabilitation). Medical rehabilitation is the responsibility of the patient’s doctor including the physiotherapist, nurse and others; social rehabilitation is the responsibility of the family and social worker, and industrial rehabilitation is the responsibility of the Department of Employment, Labour and Productivity.

Staff involved in Rehabilitation

Whatever the disability and whatever the severity, rehabilitation aims at achieving maximum activity in a disabled patient and requires the cooperative efforts of various medical experts. Rehabilitation is therefore the combined responsibility of the following medical personnel.

The Doctor: The doctor carries ultimate responsibility for the disabled patient, and coordinates the activities of other members of the team involved in the rehabilitation of the patient. He also sees to the medical treatment of the patient’s injury.

Physiotherapist: His duty includes:
- the physical assessment of the disabled person;
- mobility e.g. walking re-education and management of wheelchair users;
- physical problem of mobility, e.g. to toilet, bath, etc. and
- use of hoists, lifts, etc.
Occupational Therapist: His duty includes:
- functional assessment;
- physical problems of dressing; feeding, washing and toilet arrangement;
- housing (design and alteration);
- training for work, limited activities and hobbies.

Nurse: her duty includes:
- nursing care;
- prevention of pressure sores in paralysed patients or patients with sensory loss;
- management of urinary incontinence;
- care of bowels in patients unable to defecate.

Technician: His duty includes:
- design and development of appliances and aids;
- provision of aids and equipment;
- adaptation of standard equipment for special needs of individual patient.

Medical Social Worker: His duty includes:
- social and domestic assessment;
- discussion with patient to identify the patient's needs;
- planning the final resettlement.

Industrial Rehabilitation

Many people who have been ill, or are handicapped in one way, may need help in returning to working fitness or in finding suitable jobs. Such persons, who as a result of illness or disability have been unable to carry on with their former jobs, or to find work at all because of their circumstances, will benefit from industrial rehabilitation.

Industrial rehabilitation units are run by the Department of Employment, Labour and Productivity. A number of voluntary agencies and vocational organisations also run vocational training courses for disabled persons. An industrial rehabilitation unit
comprises a Rehabilitation Officer, Medical Officer, Occupational Psychologist, Social Worker, Occupational Supervisor in-charge of workshops and Disablement Resettlement Officers (DRO).

The aim of the industrial rehabilitation unit is to make work alternative for those who have lost the habit through illness or injury. The activities of an industrial rehabilitation unit includes:

1. Assessment of the potential of the disabled person in terms of functional ability.
2. Provision of appliances, aids and equipment.
3. Training of the disabled person to use his residual ability to take him to maximum competence.
4. Assistance and support of family in the care of and the acceptance of the disabled members.
5. Resettlement of the patient into the community from social and economic aspects.

The individual rehabilitation unit and centres run vocational courses for disabled persons lasting six weeks to a few months, but the precise time of stay of each patient depends on his progress. The rehabilitation of a disabled person is based on a detailed initial assessment of the patient's disability. The assessment is also aimed at establishing the patient’s intellectual, educational, and physical and mental capability and his capacity for further training. In the workshop sections, ability to operate a variety of machines, to do packing and assembly work, and performance of things like bench work, spot welding, etc., are assessed.

The disabled persons after the assessment can now undergo a course in different technical work, manual and clerical labour. The workshops have facilities for woodwork, bench engineering, watch making, shoe making, book binding, clerical work, machine operation, gardening, etc. and the working conditions in the centre are as similar as possible to those outside, so that people taking courses are trying out their skills and abilities in a realistic environment. Instructions are given by workshop supervisors experienced in the industry and trained in instructional techniques.
Resettlement

Resettlement means placing a person in suitable work, whose impairment has disabled him from returning to his previous employment. The aim is to resettle the person, whatever the degree of disability in a suitable open employment side by side with non-disabled persons. Their work may be modified or they may have certain aids provided by the establishment or the Department of Labour and Productivity. Where the person is too handicapped to work in an open industry, he is resettled in a sheltered workshop. Sheltered workshops are special work places where disabled persons who are not capable of working in open industries practice their trades usually under expert supervisors and modified work environment. Work in an open employment should be the first objective of industrial rehabilitation for any disabled person. Even while working in a sheltered workshop, the process of rehabilitation continues and some workers may proceed to open employment as soon as possible.

Sheltered workshops, since they need substantial external financial support, are usually provided by the state or private organisations, such as charity or religious bodies. The workers work at their own pace and under special conditions such as limited number of working hours. The production of some sheltered workshop, though of high quality, is usually not enough to support the workers and so the employees need to be supported partly by donation and funds from outside. Sometimes, the work they do is on contract to local firms on a commercial basis.

Disablement Quota

In many countries the government has policies to assist disabled persons get employment. In some countries a quota system (the disabled persons' employment quota) is set up by law whereby employers with a given number of workers are required to have a certain percentage (e.g. one percent) of the work force formed by disabled persons.
Factors Affecting the Success of Rehabilitation

Certain factors affect the success of rehabilitation and they include:

(a) **Duration of disability and the lapse before start of treatment:** Those seen at the earliest opportunity and for whom the treatment is commenced early have a better chance of successful rehabilitation.

(b) **Personality, intellect and educational background of patient:** Successful rehabilitation also depends on maximum patient's co-operation and this is forth-coming when the patient understands sufficiently or is intellectually capable of participating with the rehabilitation team.

(c) **Age at onset of disability:** Patients whose disabilities started earlier in life gain significant higher levels of achievement.

(d) **Family and social support:** Good family and social support will give the patient a better incentive, determination and will-power.

(e) **Attitudes of doctors:** A positive attitude from the doctor will help the patient achieve the goals set. Some doctors are concerned only with the physical recovery of their patients and do not consider the patient's rehabilitation as part of their duty.
Standards of health and safety at work depend to certain extent on legislation and the effectiveness of its enforcement. Industrial legislation is designed to improve standards of health and safety and welfare of the workers and so improve productivity. Unfortunately, the development of industrial legislation has not kept pace with increased industrialisation in many developing countries. The first comprehensive code of health and safety in Britain was the Factories and Workshops Consolidation Acts passed in 1901. In 1934 the first Factory Act was passed in Britain which was not generally different from that of 1901.

Nigeria, like many developing countries, adopted the industrial legislation of the colonial masters. Following the independence, attempts were made by successive governments to revise the legislation and laws as circumstances and needs demanded. The Workman’s Compensation Ordinance was introduced in Nigeria in 1941 but was later replaced by the Workman’s Compensation Decree of 1987.

Workman’s Compensation Decree

This decree deals with compensations for injuries arising from work. Generally, three types of claims for damages can be made against the employer. They are:

(i) The injury benefit, including claims for accidents and diseases arising out of and in the course of employment.

(ii) The disablement benefit which can be claimed when an industrial accident or prescribed disease leaves the worker with some physical or mental handicap, and

(iii) The death benefit paid when death results from an injury or disease that could have entitled a worker to injury or
disability benefit if he had lived or survived the disease or injury.

Benefits are claimed for two types of diseases, viz: a disease caused by an industrial accident and a prescribed disease. Prescribed diseases are diseases prescribed by regulations in relation to certain types of employment and which occurrence in the worker attracts payment of a compensation.

Factories Act

These are laws that apply to safety, health and welfare at work. The Factory Act was enacted in Nigeria in 1956, amended in 1958 and replaced by the Factory Decree of 1987. The earlier Factory Laws in Nigeria are not generally different from the British Factory Act of 1937. The Factories Act stipulates some requirement for work situations and provides for inspectors to police industry and ensure compliance to the stipulated requirements. By the Nigerian Factory Decree of 1987 this responsibility is assigned to the Factory Inspectorate Division of the Federal Ministry of Labour and Productivity.

A factory is defined in the Act as any premises where ten or more persons are employed in manual work in making, altering, cleaning, washing, breaking up or demolishing anything or adapting anything for sale. Such work must be carried out as a business for the purposes of profit or gain.

Various provisions are given in the Factory Act to improve the standards of health and safety of workers. The provisions are arranged in sections for ease of reference in the following order:

- Part I of the Factory Act deals with the definition of a factory, registration and notification of change of business premises.
- Part II deals with the various legal provisions for health, safety and welfare of workers and include cleanliness of factories, over-crowding, ventilation, lighting, drainage of floors and sanitary conveniences.
Part III deals with safety in general and includes safety of powered and other machineries e.g. through proper guarding or fencing.

Part IV deals with welfare and includes water supply, washing facilities, cloak room, staff canteen and provision of first aid box or cupboard.

Part V deals with special provisions and regulations such as provision of protective wears or devices and the right of a Factory Inspector to collect sample of substance used in the industry for analysis.

Part VI deals with notification and investigation of accidents and industrial diseases, and states that any accident at work resulting in loss of life or disability for three days or more must be reported in writing to the nearest Factory Inspectorate. Also all occupational diseases are to be reported to the Factory Inspectorate of the Ministry of Labour and Productivity.

Notifiable Occupational Diseases
In Nigeria the list of occupational diseases which occurrence must be notified or reported include:

1. Lead poisoning or poisoning by any lead compounds
2. Phosphorus poisoning or its compounds.
3. Mercury poisoning, its amalgam or compounds.
4. Manganese poisoning.
5. Arsenic poisoning.
6. Aniline poisoning.
7. Carbon bisulphide poisoning.
8. Benzene poisoning.
9. Chrome ulceration of the skin.
10. Anthrax.
11. Silicosis.
12. Pathological manifestation due to ionising radiation.
13. Toxic jaundice (i.e. jaundice due to toxic substances).
14. Toxic anaemia (Anaemia due to toxic substances).
15. Primary epitheliomatous ulceration of the skin due to handling of tar, pitch, bitumen, mineral oil, paraffin or their compounds.
16. Poisoning due to halogenated aliphatic hydrocarbon.
17. Compressed air illness (Decompression syndrome).
18. Asbestosis.

Part VII of the Act deals with miscellaneous provisions and includes the power and duties of inspectors, duties of employers, duties of employees, and passing of abstract of regulations and notices in permanent and conspicuous positions in factory for all to read.

It is noteworthy that the provision in respect to the duties of the employers has been well addressed by two of the four important and famous aphorisms of Sir Thomas Legge, the first medical inspector of factories in Britain which states as follows:

"Unless and until the employers have done everything — and everything means a good deal — workers can do next to nothing to protect themselves, although they are naturally willing to do their share", and

"all workers should be told something of the danger of materials with which they come in contact and not to be left to find out for themselves — sometimes at the cost of their lives."

In Nigeria as well as in most developing countries, the enforcement of this legislation is rather weak. Sometimes the legislation is theory and not practised due to various reasons which include, among others:

(i) Lack of trained factory inspectorates to enforce the legislation.
(ii) Ignorance of both the workers and many employers on the existence of the laws.
(iii) Corrupt practices which invade the entire system, including the system of law that will give judgment on the cases.
REFERENCES


62.


The human environment can be defined as the general surroundings of man and consists of the physical, biological and social environment.

The physical environment comprises the non-living part of the environment, e.g. radiation, noise and atmospheric variations (heat, cold, air pressure). Other physical surroundings of man include the air, water, food, light, etc. Some of these physical factors are very vital for life. For instance, there can be no life without air, water, food, heat or light.

Biological environment includes all living things, e.g. plants, insects, animals and microorganisms (viruses, bacteria, fungi, etc). Their existence depends to a large extent on the physical environment. For instance, the types of plants and animals found in a place depend on the characteristics of air, water, food, temperature, humidity, etc existing in the area. The high temperature and humidity of the tropical environment thus favours the rapid proliferation of disease vectors and microorganisms and the abundance of such diseases as malaria, filariasis, onchocerciasis and other vector-borne diseases.

The social environment or socio-cultural environment is that part of the environment which plays a prominent role in determining the mental health of man and includes all the conditions affecting man as a member of the society, e.g. the culture, including beliefs and attitudes, educational system, housing, etc. The continuous interaction between man and his social or psychological environment may influence his health either positively or negatively.

Man through his activities and actions effects changes in the environment. The changes may affect man directly or indirectly through his supplies of water, food and other conditions. Man can thus pollute his environment through his activities and preoccupations. The term environmental pollution has been properly
defined as the unfavourable alteration of our surroundings wholly or largely as a by-product of man's actions, through direct or indirect effects of changes in energy patterns, radiation levels, chemical and physical condition and abundances of organisms. In simple terms, when man works, plays, breaths, fights or eats, he creates environmental stresses which may in turn exert some influence on his health.

Diseases, especially the communicable diseases, but also the non-communicable diseases, result from an interaction between a host, an agent, and the environment (Figure I). In an ideal situation, the agent, the host and the environment maintain a dynamic state of equilibrium. A change in the environment can upset the balance leading to multiplication and spread of disease agents or their contact with man.

**FIGURE I: The Epidemiological Triangle**

![Epidemiological Triangle Diagram](image)

**ENVIRONMENTAL HEALTH**

It is necessary to maintain a healthy environment in order to prevent or control a variety of disease conditions that may result from poor environment. Environmental health has been defined as the control of all those factors in man's physical environment which may exercise a deleterious effect on his physical, mental or social well-being. Thus the process of taming the environment so that it does not constitute hazard to man is known as environmental sanitation. In particular, environmental health or environmental sanitation deals with the following activities:
1. Provision of a safe and adequate supply of water.
2. Proper and safe disposal of sewage (Excreta disposal).
3. Proper disposal of solid waste (Refuse disposal).
4. Safeguarding of food supplies, i.e. to ensure that they are safe (Food hygiene).
5. Provision of good housing with as few opportunities as possible for direct transmission of disease, especially respiratory infections.
6. Control of disease vectors and pests (e.g. arthropod, rodent, mollusc or other alternative hosts associated with human disease).
7. Control of atmospheric pollution, i.e. to ensure that the external atmosphere is free from deleterious elements and that the internal condition of workshops, houses, etc. is suitable for the occupants.
8. Elimination of other hazards, e.g. radiations, noise, temperature, etc.

The measures adopted to control or protect the environment are based on the observation of the relationship between the environmental factors and disease and do not have the same formula. Such measures range from specific technological measures to health education and health legislation. The public health problems posed by environmental pollution also vary from place to place. In most developing countries, the areas of water supply, sewage and solid waste disposal appear to be of greatest priority followed by food hygiene and vector control. In industrialised countries, control of air pollution as well as accident prevention are of great importance, although these problems are becoming of increasing importance also in some developing countries following urbanisation and industrialisation.

The responsibility for environmental sanitation in many countries is that of the Ministry of Public Works and local authorities. In Nigeria, environmental sanitation has remained largely the constitutional responsibility of the local government authorities. Many of the problems in environmental sanitation are dealt with by public health or sanitary engineers, technicians and environmental health officers formerly known as the public health superintendents.
The doctor should however be familiar with the basic principles involved so as to be able to give informed support and advice to his environmental health team. This is also important as usually in most developing countries no one wants to take responsibility for environmental sanitation for the small villages and rural areas except the Ministry of Public Health.
Chapter Eleven

WATER SUPPLY

In developing countries less than 25% of the rural population have an adequate water supply while only about 75% of the urban population have access to piped water. This situation has continued to get worse and is aggravated each day by population growth and by serious delays in remedial action due to poor economic conditions. The importance of water supply and sanitation, as essential public health measures, has been underlined by the recommendations of the United Nations Conference on Human Settlement (1976) and the United Nations Water Conference (1977), viz: the adoption of programmes based on realistic standards for quality and quantity, with a view to providing safe drinking water and adequate sanitation for all.

Water that is safe and acceptable for drinking is called potable water. Such water must be free of impurities, including pathogenic organisms and aesthetically appealing.

Characteristics of Water

Potable water must process the following general characteristics:

(i) Physical Characteristics

Appearance – must be clear and aesthetically appealing.
Odour – must be odourless.
Taste – must be tasteless.
Turbidity – must contain no impurities or suspended particles.

(ii) Chemical Characteristics

Should be free from toxic chemicals, e.g. lead (not more than 0.1mg/l), arsenic (0.05mg/l), iron (0.05mg/l), cyanide (0.05mg/l), cadmium (0.01mg/l), mercury (0.001mg/l), fluoride (0.0mg/l) and nitrate (45mg/l).

Water is said to be hard if it contains excessive amount of calcium and magnesium salts. Temporary hardness caused by the
The presence of calcium and magnesium carbonate and bicarbonate can be removed by heating. Hardness of 100 parts per million (ppm), the so-called calcium carbonate hardness is soft enough for household use and can be removed by addition of lime or soda which will precipitate out calcium carbonate and leave a residual hardness of less than 100 ppm.

Permanent hardness (non-calcium carbonate hardness) caused by the presence of calcium and magnesium sulphate and chlorides cannot be removed by boiling. Hard water does not lather well with soap and apart from being unsuitable for washing, may cause digestive disorders in some people.

(iii) Biological (Bacteriological) Characteristics

Drinking water should not contain disease carrying organisms e.g. bacteria, protozoa, virus or fungus. Coliform organisms are used as indicators of recent faecal pollution and drinking water should not contain E. Coli in 100ml of water tested. A high coliform count of 10 coliform/100nl or more is regarded as being suspicious or bad.

Coliform count (presumptive coliform count) of less than 10 coliform in 100ml of water may be "acceptable", especially for developing countries.

Requirement of Water

The amount of water required daily for maintenance of life is about 2 litres and could be more in warm climate countries. Depending on the source of supply and other activities carried out such as washing, cooking, laundry, gardening, flushing of toilet, etc, much greater quantities are required daily per person, about 20 litres if water is drawn by hand from an outside well, 45 litres if collected from a single tap in the house, and 150 litres if piped to sink, wash basin, bath, water closet, etc.

Sources of Water

Sources of water are rain, surface water (streams, river, lake, sea, etc) and underground water, e.g., wells, boreholes and springs. Rain water is pure but may pick up impurities from the atmosphere, roofs, roof gutterings and storage tank. Surface water is...
easily contaminated by human beings and animals and must be purified before use. Underground water may be quite pure and safe for drinking provided that the source is protected from contamination by animals or human beings or surface water.

Protection of Wells (Qualities of a Good Well)
Wells are access ways to underground water, which is raised to the surface by a variety of means. It can be a shallow well, i.e. when the water is collected above the first impervious layer, or a deep well, i.e. when the water is drawn below the first impervious layer.

To be properly protected from contamination,
(i) a well should be sited at least 100ft and preferably uphill from any potential source of pollution, e.g. pit latrine;
(ii) there should be water tight lining for at least 10 feet from the surface;
(iii) there should be a concrete platform (parapet) about two feet high surrounded by a concrete apron to drain the waste water away;
(iv) there must be a water tight cover, and
(v) water should be drawn by a pump or atleast a permanent bucket attached to the well.

Water-Related Diseases
Water can become unsafe due to the presence of micro-organisms. Water-related diseases can be classified according to their transmission mechanism as follows:

<table>
<thead>
<tr>
<th>Transmission Mechanism</th>
<th>Examples of Diseases</th>
<th>Preventive Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Water-borne (Faecal-oral)</td>
<td>Cholera, Typhoid, Paratyphoid</td>
<td>Improve quality of water, Avoid use of doubtful water.</td>
</tr>
<tr>
<td></td>
<td>Infective Hepatitis, Poliomyelitis</td>
<td>Reduce contamination of water by excreta.</td>
</tr>
<tr>
<td></td>
<td>Dysenteries.</td>
<td></td>
</tr>
</tbody>
</table>

70
2. Water-borne Schistosomiasis, Guinea worm, Paragonimiasis, Decrease need for contact with water, Control intermediate host population, Reduce contamination of surface water by excreta.

3. Water-washed (water shortage) Skin and eye infections: scabies, conjunctivitis, trachoma. Increase water quality, Improve access and reliability of water supply.

4. Water-related insect vector Malaria, Onchocerciasis, Filaria, Yellow Fever, Trypanosomiasis (sleeping sickness). Improve surface water management. Destroy breeding sites of insects, Decrease need to visit breeding sites. Use mosquito nettings.

5. Water chemical (a) Shortage of chemical, e.g. iodine, Defluoridation of water, Iodine supplementation
(b) Excess of chemical, e.g. fluoride, Fluorosis

Treatment of Water
Treatment or purification of water can be achieved through the following stages:
(a) Protection of Source: Human beings and animals should be prevented from having contact with surface water. Waste water, refuse or industrial waste should not be channelled or disposed into sources of water supply. Farming and other
human activities around such areas which form the catchment areas should be avoided.

(b) Storage: This will remove some human pathogens with short life in water, e.g. cerceria of schistosomiasis which can survive only 48 hours in water. Large solids will also settle during storage.

(c) Sedimentation and Coagulation: Addition of alum (aluminium sulphate) causes flocculation and sedimentation of much finer sediments that cannot be removed by simple sedimentation. Such substances like alum which can attract together colloidal substances to form larger particles to such a size that become heavy and settle are known as coagulants and the process is known as coagulation. Addition of alum therefore accelerates the rate of sedimentation.

(d) Filtration: This process will remove pathogenic bacteria, protozoal cyst and large viruses. Smaller viruses will however pass through the filter (filterable viruses). Various devices are used for filtration, including thick white linen cloth which may remove large particles or organisms such as cyclops — the intermediate host of guineaworm from the water. For domestic filtration, a candle filter made of fine clay is also used.

For commercial water filtration, two methods are used, the slow sand filter and the rapid sand filter. A sand filter consists of sand and stones of graded size, with fine sand at the top and large stones at the bottom. Between the sand and the bed, are 3 or 4 layers of clean gravel with the gravel in each layer being of uniform size and twice as large as the gravel in the layer above. Rapid sand filter in comparison with slow sand filter is achieved by the use of larger sand grains in the beds and by pre-coagulation of the water with chemical compounds.

(e) Disinfection: This is a process of water treatment which aims at complete destruction of pathogenic organisms which may escape other processes of treatment. Disinfection of water may be achieved by heat, ultraviolet rays, or use of chemicals or a combination of these methods.

72
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The commonest method of disinfection of large municipal water supply is by use of appropriate chemical, notably chlorine—chlorination. Other chemicals that can be used include iodine, ozone, milton and potassium permanganate. Chlorine may be used in a form of chlorine gas or as bleaching powder (Chloride of lime), liquid bleach or hypochlorite. Chlorine gas is given in a concentration of 1 ppm released from a cylinder by means of a measuring device—the chlorinator. During emergency, e.g. epidemics of water-borne diseases, super-chlorination is used and this is achieved by the application of dose of chlorine which considerably exceeds that normally required to disinfect the water, e.g. 1.5 ppm. After a suitable contact time, the water is dechlorinated using chemicals such as sulphur dioxide, sodium bisulphate and sodium-thiosulphate. Some chlorine tablets are also available in the market for domestic purification of water and at the time of emergency and they include “Halozone”, “Chlor-dechlor” and “hydrochlorzone” among others.

f. Boiling: This is also a reliable method of water purification used commonly during emergency conditions and in special circumstances e.g. infant feeding. Its disadvantage lies in the fact that it cannot be used on a large scale due to high cost of fuel.
Chapter Twelve

SEWAGE DISPOSAL

One of the most important public health activities is the removal of human excreta from continuous human contact. This function has been recognised and effectively implemented in developed countries where the concern today is not much with the removal of excreta from the place of dwelling, as with their disposal or treatment at more remote points. In developing countries on the other hand, man’s wastes are in daily intimate contact with man leading to grave public health problems. It is estimated that only about 35% of rural dwellers in developing countries have adequate sewage disposal system while only about 75% in the urban communities have access to reasonable sanitation facilities.

Sewage has been described as a collective name for liquid or wet refuse consisting of excreta (faeces and urine), effluents from bath, kitchen, laundry, rain run off waste-water and industrial waste-water. The term sullage is often used for waste-water from bathrooms, kitchen and laundry devoid of excreta. The pipes through which sewage flows are known as sewers and the network of such pipes is known as sewerage.

Methods of Sewage Disposal

The methods of disposal of sewage from a community depends on the type of sewage. A good sewage disposal system must have the following characteristics:

1. It must not pollute the surface of the soil;
2. It must not contaminate or pollute the surface water or the ground water;
3. It must not make sewage accessible to flies and other animals;
4. There must be no handling of fresh sewage;
5. It should not be unsightly or smelly.
6. The method must be simple and affordable, and should be acceptable in terms of cultural belief of the community.

A. The Non-Water Carriage Systems

1. The Pit Latrine

The pit latrine is ideal in rural areas and other communities where there is scarcity of water. The conventional pit latrine consists of the pit, the floor, and the superstructure. The pit should be made as deep as possible so that it can be dark inside to discourage flies and also last many years before it is filled up. It should be at least 2.5 metres deep. The floor should be made of reinforced concrete slab to ensure that it is strong and safe. In addition, a pit latrine should be sited 6 metres from houses and 30 metres away and down hill from a water source. The pit must be provided with a tight lid.

There are many modifications of the pit latrine aimed at improving the sanitary characteristics of this method of disposal. These include the ventilated improved pit (V.I.P.) latrine, the bore hole latrine and the water seal pit latrine, etc.

A ventilated improved pit latrine has a vent pipe with a fly screen located outside the house. This helps to minimise fly and odour nuisance and makes the warm gas from the pit to move outside through the vent pipe.

Fig. 2 Ventilated Improved Pit Latrine
2. **Trench Lattice**

This type of latrine consists of shallow trenches dug in such a way that excavated soil is left close to the trench for the purpose of covering the excreta after use. Each user is expected to use some of the soil to cover the excreta after each use.

The trench latrine and the borehole latrine are useful for temporary sites such as refugee camps, work camps, picnic sites, holiday and festival camps.

3. **Composting or “Multrum”**

This is a biological destruction process whereby excreta and refuse are mixed and allowed to decompose in a corrosion-resistant container. The content of the container is turned regularly until decomposition is achieved. In multrum decomposition process takes place at normal air temperature. Humus is produced and carbon dioxide and other gases are allowed to escape.

4. **Bucket Lattice (Conservancy)**

Like the pit latrine, the bucket latrine is also water independent but has no characteristic of a good sewage disposal method. It is very cheap to start but difficult and expensive to operate. In addition the bucket latrine allows fresh handling of faeces by the night soil man as well as constitute odour and fly nuisance.

B. **Water Carriage Systems**

1. **Septic Tank and Soakaway Pit (ST & SP) Method**

This method of sewage disposal is ideal where there is some availability of water. It consists of the flushing device known as the water closet, the inspection chamber and the short pipe (sewer) which leads into the septic tank. The night soil discharges from the house through the sewer to the septic tank where it stays and anaerobic action takes place and from where a clear effluent leaves to the soakaway pit. In the soakaway pit the effluent is absorbed by the surrounding soil. The sludge in the septic tank is removed when the tank is filled.
2. **Aqua Privy**

It consists of a water-tight tank made up of concrete or any other durable materials and a floor which carries an inlet drop pipe. Feces are stored in the tank which is kept at a constant water level. A soak-away pit is also provided for the effluent from the aqua privy tank. It is important that the top of the water level is maintained constant to prevent the tip of the drop pipe from being exposed. To this effect addition of about a litre of water each time the toilet is used is recommended. Alternatively, the aqua privy tank may be connected to the bathroom so that the bath water ensures that the correct top water level is maintained.
Other methods of sewage disposal include:

1. **Chemical Toilet**

   This is suitable for mobile communities, caravans, buses, trains and aircrafts. It consists of a corrosion resistant container of about 400-500 litres containing bactericidal liquid such as a strong solution of sodium hydroxide and formaldehyde. From time to time the contents of the toilet will have to be discharged in such a way that it does not pollute the environment. Most modern chemical toilets operate with deodorising, liquefying and sterilizing liquids.

**Sewage treatment**

Sometimes the sewage of a community (e.g. housing estate, an area or a city), is collected through a sewerage system for disposal into the river, sea or on the land. The sewerage system consists of a network of underground waste pipes which are employed to collect the liquid waste from the community. The sewers or pipes are laid in such a way that the flow is under gravity.

The collection can be through a combined sewerage, i.e. the same network used for both the foul (excreta) and surface water from rainfall, or through a separate system or network for the foul sewage and another for the surface sewage. In some under-developed countries, the open drains are often used for the surface sewage, which if not well maintained encourage breeding of mosquitoes.

Sewage collected to a central point through sewage systems should be treated properly before they are discharged into the river, sea or disposed of on the land. This is to stabilise the sewage and render it harmless by destroying the pathogenic organisms through the process of decomposition.

Many methods are employed for the biological treatment of sewage and they include:

(a) The trickling biological filtration system (or biological filtration) using beds of broken stones, gravels, etc. as percolating filters.

(b) Sludge activated system which requires less space but more mechanisation and skilled operation.
(c) Waste stabilization or oxidation pond which provides a simple means of treating sewage where space is available. It is considered ideal for tropical countries with enough sunlight and high temperature.

(d) Aerated lagoon which is ideal for places where land is too expensive for oxidation ponds.

(e) Oxidation ditch which requires a lot of electrical power and is ideal for places where land is too expensive for oxidation ponds.

(f) Sewage irrigation considered suitable for developing countries where agriculture is the main stay of economy. By this method sewage is collected from sewers and sent to farms for irrigation of crops that are not eaten raw, e.g. maize, rice, etc.

Primary treatment of sewage include collection, screens, comminutor and sedimentation tank. Details of both the primary and biological or secondary treatment of sewage are not treated in this book and can be found in textbooks of environmental engineering.

The sludge removed from the sewage may be given special treatment and used as fertilizer or for composting, or incinerated.

Biochemical Oxygen Demand (B.O.D.)

Biochemical oxygen demand of sewage or other polluted water measures its organic content in terms of the oxygen required for bacterial oxidation.

Oxygen dissolved in water is used up by aerobic bacteria during oxidation of organic matter, and is especially significant in rivers receiving effluents from sewage. When such effluent is heavily polluted i.e. if Biochemical Oxygen Demand is high, the water may be devoid of oxygen and hence offensive through discharge of hydrogen sulphide.

A good sewage treatment system is designed to remove the organic matter in the sewage and yield an effluent which meets the standard recommended Biochemical Oxygen Demand of not more than 20mg/l and suspended solids of 30mg/l.
Diseases Associated with Inadequate Sewage Disposal (Sewage related diseases)

Human excreta are important source of pathogenic organisms. In most of the diseases associated with inadequate sewage disposal, the infective agent, whether bacteria, virus, protozoa, helminth, is often discharged in human faeces and seldom in the urine. The diseases are transmissible by the pathogen passing from the faeces of infected person and subsequently being ingested by a new host. They are therefore referred to as faeco-oral or fecal oral diseases and can be transmitted directly through water-borne route (e.g. typhoid, paratyphoid, cholera, dysentery, infective hepatitis, poliomyelitis, etc), or soil or vegetable (eg. ascariasis, trichuriasis), or involve intermediate host (e.g. fish tapeworm, taeniasis). Thus, all water-borne diseases can be said to be fecal oral; on the other hand, all fecal oral diseases are not necessarily water-borne and may have other routes of transmission (Figure 5). In addition sewages are attractive to flies and can lead to proliferation of flies which can contaminate food. Some examples of faeco-oral diseases are given on Table I.

The control of faeco-oral diseases is mainly by adequate disposal of sewage, i.e. by rigid prevention of contact between human waste and water, food and other materials, animals and insects. Other methods of control include provision of good water, personal hygiene, food hygiene and fly control, among others.

Fig. 5: Faeco-Oral Transmission Routes

![Faeco-Oral Transmission Routes](image-url)
<table>
<thead>
<tr>
<th>Category</th>
<th>Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water-borne</td>
<td>Typhoid, Paratyphoid, Cholera, Bacillary dysentery (Shigelosis), Amoebic dysentery, Infective hepatitis (hepatitis A), Poliomyelitis, Giardiasis, Balantidiasis, Dysenteries (E. coli, Rota virus)</td>
</tr>
<tr>
<td>Food-borne</td>
<td>Ascariasis, Trichuriasis</td>
</tr>
<tr>
<td>Intermediate Host</td>
<td>Fish tapeworm, Taeniasis</td>
</tr>
</tbody>
</table>
Refuse is the inclusive term for all solid waste products or substances produced in homes, agriculture and live-stock activities and in industries. They include vegetable wastes, animal wastes and mineral wastes. A typical Nigerian solid waste is composed of leaves, food items (garbage or kitchen wastes), paper, cartons, tags, plastic and polythene, tins and metals, bottles and glasses as well as ashes, dust, stone and other miscellaneous substances. These are dry refuse as opposed to wet or liquid refuse consisting of human faeces, urine, effluents from the bath and kitchen (sewage).

Solid wastes, if not properly disposed of will lead to offensive conditions such as bad smells, fly, and mosquito breeding, proliferation of rats and other vermin and the spread of infectious diseases.

Indiscriminate disposal of refuse will also lead to fire outbreak and injuries, especially to children playing around and cause flooding by blocking of rivers and drainage channels. A satisfactory refuse disposal service must aim at not polluting the environment, namely water, land and air.

Poor refuse disposal is a serious public health problem in most developing countries. In Nigeria the importance of refuse disposal as a public health problem has been underlined by the establishment in 1988 of Federal Environmental Protection Agency (FEPA), which is empowered to take care of all gaseous, liquid and solid waste handling and disposal, In addition, State Environmental Sanitation Authorities have been set up to assist in waste management. Unfortunately, these measures have failed to achieve the desired effects, as responsibilities among the various agencies (LGA, FEPA and State Environmental Authorities) often overlap and sometimes conflict.
Diseases Associated with Refuse Disposal

Improper disposal of refuse will lead to mosquito breeding as well as breeding of other flies and of rodents and the spread of the following infectious diseases:

1. Fly transmitted infections e.g. myasis, seldom diarrhoea, typhoid, cholera.
2. Rodent transmitted diseases e.g. lassa fever, plague, leptospirosis, murine typhus.
3. Mosquito-borne Diseases e.g. malaria, yellow fever, filariasis, dengue haemorrhagic fever.

Refuse collection methods include:

(a) House-to-House Collection: Metal or plastic bins with lids or disposable refuse bags used by house holders for storage are kept at a place accessible to refuse collectors.

(b) Bulk Bin Collection: This could be heavy galvanised metal dust bin like mammoth and Dinosaur sited at centralised place for communal refuse collection. Sometimes refuse houses are provided for communal collection and storage of house hold refuse prior to their removal by tippers to final disposal site.

It is important that refuse is kept dry during periods of storage because an accumulation of moist refuse will not only be difficult to remove but will also give rise to offensive odour as well as form an excellent breeding media for flies.

Transportation of Refuse

The refuse is collected frequently by the responsible agency, e.g. the local government, and transported to final disposal sites in special vehicles. Frequency of collection will depend on the type and volume of refuse - weekly or twice weekly for house refuse; thrice weekly or daily for hotel, restaurant, office, trade or market refuse. A variety of special vehicles are used in the transportation of refuse to the disposal sites and include trucks (closed and open top), compression type vehicles and the maximum pail loaders (MPL) system.
Bailing, that is compressing the lose mixture of refuse into dense bails, is achieved by using hydraulic rams or different mechanisms inside the collecting vehicles. This will lead to reducing the volume of the refuse and so save the size and number of vehicles required for transport and the land space needed for tipping.

Refuse Disposal Methods

The choice of a method for disposal of refuse will depend on the physical characteristics of the locality, e.g. the topography of the area, the character, quality and quantity of the waste, and the community. The consideration in choosing a method for waste disposal should however be the public health aspect.

The following methods of refuse disposal are currently in use:

(a) Controlled Tipping or Sanitary Landfill

This method is useful in land reclamation of gullies, excavation and low land areas and does not require high technology to operate. Refuse is piled up in 2m layers and covered daily with 20-25cm of soil or sand. Also known as cut and cover in America, sanitary landfill is about the cheapest method of final disposal of refuse anywhere in the world.

(b) Composting

A mixture of compostable refuse and other nitrogen rich decomposable wastes (e.g. night soil, sludge) is heaped for several months with periodic turning. The end product, manure, is used in gardening or farming. Separation is necessary before composting but this exercise adds to the cost. Moreover, there could be odour and fly nuisance if not properly managed. In developed countries sophisticated compost plants are used but these are very expensive.

(c) Incineration

Refuse is sorted out and combustible matters are dried up and burned in a large incinerator maintained at 900°C - 1200°C. A major disadvantage of the method is air pollution. High technology
incineration as a method of treatment of refuse is very good. It kills all pathogenic organisms, render hazardous wastes harmless but it is very expensive and complex for use in developing countries. Simple incinerators can however be constructed for use by communities in developing countries.

(d) Mechanical Destructor
This is a plant used for treating refuse. After sorting out all that could work against the machine, what remains is fed into it for pulverisation and the end product used as manure or buried in a small area of land. This method is very good in cities where the volume of refuse generated daily is enormous. Running cost is very high.

(e) Sea Disposal or Berging
This method is popular for coastal areas. Refuse is dumped directly into the waters of a river or sea at a distance to prevent refuse being carried back to shore by tides and causing nuisance. Boats specially equipped to deposit the refuse through the bottom are often required. For toxic or radioactive wastes, these are sealed in water-tight containers and buried in deep seas. Water pollution is the main disadvantage of this method.

Other methods of refuse disposal that are commonly used by households in rural areas of developing countries include:

(i) Indiscriminate dumping on farm lands and
(ii) burying.

Recycling of Wastes (Salvaging)
Some waste products can be made useful through recycling. Recycling is practiced in conjunction with any of the principal methods of waste treatment described above.

Scavengers all over the world make a living by recycling useful waste products from refuse dumps. Waste products picked from dumps for reuse include cans, plastic containers, bottles, rags, shoes, metal scraps, etc. Synthetic fuel and biogas can be produced from
any waste with high organic content. Agricultural, animal and human wastes which are all organic matters could be used to produce synthetic fuel or biogas.

Problems of Waste Management

In Nigeria like in most developing countries problems of waste management include:

(i) Lack of resources (money, material and manpower). Material resources include all sorts of vehicles and plants for refuse disposal.

(ii) Inadequate public enlightenment and community participation.

(iii) Constitutional problem, namely, fragmentation of responsibilities for solid waste management.

(iv) Lack of essential statistical data for planning.
A house is a man-made physical structure which is designed to offer shelter to human beings. A house should be built to meet the physiological and psychological needs of human beings and sited in a suitable environment such that will enable its occupants to live a healthy and reasonably comfortable life.

The soil on which a house is sited must be strong enough and must not be water logged. Low-lying lands and lands recently reclaimed with refuse should be avoided as they are not strong enough and could affect the structural safety of the building. Lands reclaimed with refuse will require at least 10 years and longer to consolidate before they become suitable for building a house.

Qualities of a Good House

A good house must have the following basic facilities:

(a) Basic Physiological Needs
- Satisfactory lighting – adequate day light; admission of direct sunlight.
- Satisfactory ventilation – free circulation of air; indoor air of acceptable quality.
- Protection against excessive noise.
- Maintenance of conducive thermal environment.

(b) Basic Psychological Needs
- Separate rooms for sleeping and living with adequate lighting and space for movement and free circulation of fresh air.
- Adequate privacy for the individual and possibly separate rooms for both children of different sexes that are above 10 years of age.
- Adequate open space for recreational activities and relaxation for mental stimulation.

(c) Protection Against Contagious Diseases
- Adequate sanitary facilities such as toilet, bathroom and good sewage disposal facilities.
- Adequate kitchen and storage facilities safe from contamination.
- Adequate refuse collection and disposal facilities.
- Adequate potable water supply.

(d) Protection Against Accidents
- Must be designed and built with proper materials as to prevent accidents, fire, electrical shocks, poisons and mechanical injuries due to collapse of any part of the building.

Health Hazards Associated with Bad Housing

The striking features of poor housing are:

(a) Overcrowding and diseases associated with overcrowding, notably respiratory infections (pneumonia, bronchitis, tuberculosis, cerebrospinal meningitis, measles, etc.).

(b) Lack of basic sanitation leading to gastro-intestinal infections (diarrhoea and dysentery), infectious hepatitis, etc.

(c) Filth which will attract flies, lice, fleas, bugs, flies, mosquitoes and rodents, all of which transmit a variety of diseases.

(d) Behavioral disorders, nervous irritability, bad temper and mental unrest associated with homes lacking basic psychological needs.

(e) Accidents and injuries from falls, burns, electrical shock, as well as atmospheric pollution from smokes, excessive noise and poor lighting resulting from bad designs of homes.

(f) Lead in paint can constitute danger to children who can become ill from eating or sucking flaking lead paints on old houses. Signs of lead poisoning in such children include anaemia,
fatigue, weakness, anorexia, foul breath, indigestion and abdominal pains.

**Building Regulations and By Laws**

These are meant to ensure that the building does not endanger lives during and after construction and that it promotes health and provides maximum comfort and safety. They provide standards on areas such as density in terms of number of living units per unit area of land, building height, room sizes, room occupancy rate, etc. While regulations are of general application, the bye laws are often restricted to the local government or the planning authority.

In Nigeria, some of the regulations and by-laws for building are as follows:

**Size:** Building should occupy a maximum of 50% of the plot size for high density area, 45% for medium density and 35% for low density.

**Room Size:** This should be as large as possible and at least 10.8 sq metres (120 sq ft). The side of the room should not be less than 2.4 metres.

**Height of Room:** The eave height should be at least 1.68 metres from the ground level.

**Ventilation:** Total area of window or ventilation opening must be at least 1/8th of the total floor area.

**Maximum Allowable Occupancy Rate**

Most African countries do not enforce maximum allowable occupancy rates. In Nigeria for example, such a rate is not in any regulation or bye-laws. In accordance with world standard, it is expected that an average family between 6 to 10 individuals should live in a dwelling between 4 to 5 habitable rooms so as to give an occupancy rate of approximately 2 per room.
Building Plans

In inspecting a building plan, the Health Officer must bear in mind all the above requirements and pay attention to the following areas:

1. Site and size of the plot of land.
2. Size of the building in relation to the plot of land.
3. Space between the proposed building and adjacent buildings.
4. Room sizes.
5. Position and area of windows and doors to ensure adequate ventilation and lighting.
6. Availability of adequate sanitary facilities and their location in relation to the kitchen and the rooms.
Chapter Fifteen

FOOD HYGIENE

Food hygiene may be defined as all conditions and measures that are necessary during the production, processing, storage, distribution, and preparation of food to ensure that it is safe, sound, wholesome, and fit for human consumption. Food hygiene deals with the prevention of contamination of foodstuffs at all stages of their production, e.g. from the time the foods are produced to the time they are served for consumption. It covers proper handling of foodstuffs and drinks, all the utensils and equipment used in food preparation, service and consumption, as well as the care and treatment of foods known to be contaminated with poisons or pathogenic micro-organisms which have originated from the food material.

At several points along the chain, i.e. from production to the home of the consumer, all those who handle food are of vital importance in food hygiene and safety. A food handler is defined as one who touches the food, or the implements or machinery with which the food comes into contact, or the material in which the food is packed. This definition implies that a large proportion of people who represent potential risk to food can be identified clearly from any screening programme.

Food Poisoning

Food poisoning is loosely used to cover both infections and intoxications caused by eating contaminated food. In developing countries, the warm environment provided by the high ambient temperature favours the multiplication of micro-organisms which cause food to spoil and lead to food poisoning. Sometimes, the food may look attractive and normal in smell and taste, and yet cause acute illness almost immediately after consumption or after a period of time due to toxins produced by bacteria.
Such toxins (enterotoxins) are resistant to heat to a marked degree and need very high temperatures to achieve destruction. Food poisoning caused by *Staphylococcus aureus* and *Clostridium* organisms (botulinum and perfringens) are due to the ingestion of toxins formed by the multiplication of the organisms in food. This condition is strictly an intoxication and not infection.

Food poisoning in the tropics is commonly due to the following organisms: *salmonella* organisms, *staphylococcus* and *clostridium* organisms, especially *Clostridium welchii* (perfringens). In temperate countries frequent causes of bacterial food poisoning include *staphylococcus, salmonellae*, group A *streptococci*, *shigellae*, the *Vibrio cholerae* and *haemolyticum* and more rarely *Clostridium botulinum*.

Most of the organisms causing food poisoning have variable incubation periods, e.g. *salmonella* organisms – 12 to 24 hours or days; *staphylococcus* – 1 to 6 hours; *Clostridium welchii* – 10 to 24 hours. The symptoms include diarrhoea, vomiting, abdominal pains, chills, prostration and gastroenteritis. While *salmonella* and *staphylococcal* food poisoning typically present with diarrhoea and vomiting, vomiting is not so common in *Clostridium welchii* food poisoning. The organisms can frequently be isolated from the stools and vomitus as well as from the infected food.

*Staphylococcal* food poisoning is due to the ingestion of enterotoxin produced in food contaminated by *Staphylococcus aureus*. The organism gains access to the food usually during preparation by a nasal carrier or by an individual with a superficial staphylococci lesion, e.g. boil, septic spots, etc. Food poisoning is most likely to occur if the food is kept under warm conditions for some time before eating, thereby permitting multiplication of the organisms in the food and formation of enterotoxin. *Staphylococcal* food poisoning is usually rapid in onset (incubation period: 1–6 hours). It is characterized by marked vomiting and abdominal pain appearing shortly after eating contaminated food. There is absence of fever and the condition is self-limiting resolving in a further 24 hours. *Salmonella* food poisoning is caused by infection with a great variety of *salmonella* serotypes (primarily of animal origin), the most
common of which are S. typhi-murium, S. enteritidis, S. thompson, S. heidelberg, etc. Infection follows about 34 hours of eating food, often inadequately cooked or food which has been kept warm after cooking. In addition to vomiting and diarrhoea which may be severe and prolonged over several days, there is usually fever.

*Clostridium welchii* food poisoning is caused by the ingestion of food containing exotoxin produced by the organism. Food, especially meat which has been kept in warm environment after cooking is the main source of intoxication. The incubation period is about 10 – 24 hours and unlike the salmonella and staphylococcal food poisoning vomiting is not very common.

*Botulism* is a special type of food poisoning due to the toxin of *Clostridium botulinum*, an anaerobic, spore-forming organism which can withstand boiling for up to 3½ hours. Intoxication occurs within about 24 hours of eating contaminated, mostly canned or bottled foods – meat, sausage (bonitus), vegetables, etc that are poorly preserved. The symptoms are usually those of the nervous system. There is paralysis of the ocular muscles leading to diplopia, protrusion of the eyeballs, prostat, loss of accommodation and dilated pupils. Pharyngeal palsy causes dysphagia, and there may be laryngeal palsy leading to aphonia or difficulty in speech. Fever is generally absent. Gastro-intestinal symptoms are very slight and there may be vomiting, but constipation is the rule. Case fatality rate is high averaging about 65%.

Apart from contamination by biological agents, food poisoning can be caused by a variety of chemicals (e.g. pesticides used to protect and preserve foods and chemical additives introduced to make the food taste, smell or look better), and by use of poisonous plants or foods containing natural toxins (e.g. cassava – cyanide, mushroom alkaloids; etc), and aflatoxins and other mycotoxins produced by moulds. The effects produced by the ingestion of foods contaminated by undesirable levels of chemicals and toxins may appear less acutely dramatic than those produced by biological agents but they are none-the-less potentially as dangerous because of their long-term impact on human health. Some mycotoxins, for example are powerful carcinogenic agents.
Food may also be the vehicle of transmission for many other infectious diseases (food-borne infections). These include typhoid and paratyphoid fevers, shigellosis, streptococcal pharyngitis, brucellosis, infectious hepatitis, amoebiasis, cholera, bovine tuberculosis, trichinosis and other helminthic infections. These are however not usually classified as forms of food poisoning.

Contamination of foods can occur at any of the several stages in the sequence of food processing, preparation, distribution and storage in commercial enterprises, public institutions, and private homes. When contamination is directly from the food material, e.g. animal suffering from salmonellosis or other disease or vegetables contaminated with *Salmonella typhi* or *helminthus*, this is known as primary contamination. Secondary contamination arises from workers with respiratory infections or skin infection and diarrhea or persons with bad habits and poor hygiene contaminating the food. Contamination can also occur during transportation – transportation contamination, or in market or farm.

**Control of Food Poisoning**

This involves the adoption of stringent food safety measures at source till the eating place.

(i) **Individual Measures**

- Health education of individuals and food handlers on personal hygiene and proper handling of food.
- Use of protective clothing by food handlers e.g. head cover, aprons, etc.
- Prompt and thorough refrigeration of food, especially meat and dairy products to avoid multiplication of bacteria.
- Medical examination of food handlers and temporary exclusion of disease carriers and those suffering from diarrhea and pyogenic skin, nails, ear, oral, eye and respiratory infections, or those with history of intestinal disease.

Since food is not a means of transfer of human tuberculosis, there is little justification for chest x-ray of food handlers unless it is done for the public or fellow workers and not as a food hygiene measure.
(i) **Community Measures**

- Veterinary inspection of abattoirs and proper ante and post mortem inspection of animals used for food.
- Proper cleaning and maintenance of utensils and equipment used for food processing, storage, preparation and serving.
- Rooms and depots in which food is prepared should be used only for this purpose and the food preparation and storage areas should be animal proof.
- Provision of good sanitary facilities, including potable water in food premises.
- Pasteurisation of milk.
- Discourage use of chemicals for meat preservation.

**Methods of Food Preservation**

The following methods of food preservation are available: refrigeration, drying, smoking, salting, pickling with brine, addition of sugar, addition of chemical pesticides, sterilisation and pasteurisation.

**Agencies Concerned with Food Hygiene**

(a) **National Agencies**

- Ministry of Agriculture, Fisheries and Food Production (on general policy issues, information on food technology — production, preservation, processing, etc.).
- Ministry of Health through its Foods and Drugs Inspectorate Division (on food standards, chemical and bacterial properties, storage and preservation methods, etc.).
- The Local (Government) Health Authority (market and meat inspection). Provision of good standards for public eating places, food premises, and food vendors, etc.
- Food and Agricultural Organisation (FAO) with headquarters in Rome (involved mainly on nutrition, nutritional education, etc.).
- Joint WHO/FAO Committee on Food Additives (concerned with assessing toxicity of additives, contaminants and pesticides, etc. in food).
VECTOR CONTROL

Vector is an invertebrate or an arthropod which harbours an infectious disease and is capable of transmitting it. Transmission by a vector is mechanical when the vector carries the infectious agent on its body or limbs or by passage of the organisms unmodified through its gastrointestinal tract. In many cases there is biological transmission by vectors, in which case there is multiplication or cyclic development of the organisms in the vector before it can transmit the infective form of the agent to man. An extrinsic incubation period is the phase within the vector during which the organism develops into an infective form. The vector becomes infective only after this period.

Pests, unlike vectors, may not transmit disease but can be of considerable nuisance to man and may affect his health indirectly.

Vector Control Methods

(a) Use of Insecticides (or larvicides)

This is now an accepted means of control of insect-borne diseases throughout the world. It involves the use of chemicals to kill the insect vectors or their larvae. In the control of guineaworm, a larvicidal, Abate is used in many endemic countries including Nigeria to kill the cyclops.

Recently use of insecticide (e.g. pyrethrum), impregnated bed nets has become very popular, especially in the control of mosquito vector.

(b) Environmental Control

This involves elimination of breeding places such as filling of drainage of impounded water, clearing of vegetation and bushes around the houses, etc.
Chapter Sixteen

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(b) Environmental Control

This involves elimination of breeding places such as filling of drainage of impounded water, clearing of vegetation and bushes around the houses, etc.
This is the use of other organisms to control the vectors. These organisms, e.g. a larvivorous fish such as Gambusia, or bacteria such as Bacillus thuringiensis, or fungi, nematodes or other biological agents compete with the vectors and by so reduce the vector population. An example of biological control is the use of Bacillus thuringiensis serotype H 14 by the onchocerciasis control programme (OCP) in Volta River Basin of W. Africa where the simuliun larvae are resistant to Abate.

Similarly, a larger number of male vectors are by radiation with UV or x-rays sterilized and these are introduced into the vector population to compete with the fertile males. This way the reproduction rate of the vector is drastically reduced.

d) Trapping or collection and destruction of vectors using various mechanical devices, e.g. sticky strips.

e) Contact Barriers

This involves the use of bed nets, protective clothing or screening of houses to reduce man-vector contact.

Insecticides in Current Use

Two types of insecticides are used in the field of public health: the non-residual and the residual insecticides.

i) Non-residual Insecticides

These are insecticides which do not possess a lasting effect because they are unstable in light and air. An example of non-residual insecticide is pyrethrum flowers. The insecticidal constituent of pyrethrum is quick acting and will have a knock-down effect or kill most insect pests which are in that room at the time of spraying. Pyrethrum can be used as dusting powder or atomised space spray or incorporated in slow-burning joss-stick type coils which produce an insecticidal smoke both toxic and repellent to insects. Pyrethrum
impregnated bed-nets have also been found effective in many areas, including Nigeria.

(ii) Residual Insecticides

These are stable, organic chemicals which, when applied to a surface, remain toxic for sometime, usually several months to insects resting on that surface. The following residual insecticides are commonly in use:

(a) Chlorinated Hydrocarbons (Organochlorines) e.g. DDT (dichloro-diphenyl-trichloroethane), Gamma BHC (Gamexane, Lindane), Chlordane (Octochlor).

(b) Organophosphates, e.g. Abate (Temephos), Ronnel (Fenchlorphos), Malathion (Cymthion), Dichlorvos (Nuvan), Fenthion (Baytex), Fenitrothion (Sumithion).

(c) Carbamates e.g. Carbaryl (Sevin), Propoxure (Baygon).

Methods of Application

Depending on the objectives to be achieved, insecticides can be applied in many ways, using the following formulations:

(i) Water-Dispersable Powders (WDP)

These are used for residual spraying of buildings and wall surfaces. Most DDT and dieldrin wettable powders contain 50 percent of the commercial insecticides, but 75 percent wettable powders are also available.

(ii) Emulsion Concentrates (EC)

Most organophosphates are also formulated as emulsion concentrates and percentage of active ingredient vary from compound to compound, for example Abate (Temephos) are available in 50 percent and 100 percent E.C.

(iii) Dusts

These are commonly used in the control of agricultural pests and against cockroaches, fleas, fly maggots and lice, the precise location...
of which is known. Dusts are finely ground mixtures of insecticides and inert diluents (e.g. talc) and usually contain different percentage of active insecticide.

(iv) Aerosols, Fogs, Vapours, Smokes, Fine Sprays
These are fine suspensions in the air of solid or liquid particles of insecticides. They are usually less than 50 microns in size that they can remain suspended in the air for some considerable time, allowing penetration where required. They can be applied by use of fogging machine, smoke generators, aircrafts or by atomizers and aerosol containers in which the insecticide is dissolved in liquefied gas under pressure.

(v) Pellets or Granules
These are used mainly as larvicide for use in shallow water breeding places with much vegetation. The granules which are made of certain type of clay impregnated with insecticide disintegrate slowly in water and release the insecticide.

Insecticide Poisoning
Insecticide poisoning can occur through inhalation, skin contact and ingestion. There is probably little risk to the occupants of treated houses, but as a safety measure, all foodstuffs should be removed or properly covered before spraying. Operators (sprayers) should also be carefully instructed in handling, and should be aware of the danger in swallowing insecticide or in excessive inhalation or contact of the substance with the skin.

Poisoning due to insecticides is discussed in Chapter Four under occupational diseases caused by chemical hazards.

Vector Resistance to Insecticides
Resistance to insecticides is common and has appeared in over a hundred arthropods of public health importance. A large number of vector species have developed resistance to chlorinated hydrocarbon insecticides and recently to organophosphate and carbamate
compounds. The widespread use of agricultural pesticides has added to the problem of vector resistance to insecticides. Where resistance has appeared to the three main groups of insecticides, the use of alternative control measures is recommended.

The Control of Specific Insect Vectors and Pests

<table>
<thead>
<tr>
<th>Vector</th>
<th>Disease</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mosquito</td>
<td>Malaria, Yellow Fever, Filarialis, Dengue Fever,</td>
<td>Residual spraying with insecticide (DDT, BHC, Chlordane), Larvicides where breeding sites are localised and not numerous. Elimination of breeding places,</td>
</tr>
<tr>
<td>(Anopheles, Culex, Aedes)</td>
<td></td>
<td></td>
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<tr>
<td>(Musca domestica)</td>
<td></td>
<td></td>
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<tr>
<td>(Phlebotomus)</td>
<td></td>
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</tr>
<tr>
<td>4. Fleas (Xenopsylla cheopis, Pulex irritans)</td>
<td>Endemic typhus, Bubonic plague (human flea).</td>
<td>Insecticide e.g. BHC dusting powder. Rat control using coagulants. Good housing.</td>
</tr>
<tr>
<td>5. Bed Bug (Cimex)</td>
<td>Not known; biting nuisance.</td>
<td>Insecticide (house spraying with special attention to crevices).</td>
</tr>
</tbody>
</table>

101
   Reduviid Bug Chagas' disease

7. Tick (Ornithodorus, Ixodes).
   Tick Relapsing Fever, Rocky mountain spotted fever, Colorado Tick Fever, Tickborne encephalitis, Tularemia.

8. Lice (Pediculus corporis, Pediculus capitis).
   Lice Endemic typhus, Lice borne Relapsing Fever.

9. Cockroaches (Blatella orientalis, Periplaneta americana).
   Cockroaches Diarrhoea, Dysentery (mechanical transmission).

10. Mites (Sarcoptes scabei, Leptotrombidium).
    Mites Scabies, scrub typhus.

11. Biting Midge (Culicoides).
    Biting nuisance

12. Black flies (Simulium).
    Black flies Osocherciiasis or River blindness.

13. Tse-tse flies (Glossina).
    Tse-tse flies Trypanosomiasis

    Scorpions Biting nuisance.

15. Ants.
    Ants Not known.

---

Insecticide as per Bed Bug.

Insecticide (DDT, BHC) powder dusting. Avoid going to tick infested area.

Insecticide (DDT, BHC) powder or dust. Avoid overcrowding. Immunization.

Insecticide. Clean environment.

Sarcopticide e.g. Benzyl benzoate. Personal hygiene.

Larvicides (DDT, BHC, Dieldrin).

Larvicides (DDT, Gamma BHC, Abate).

Insecticide Treatment and education.

Insecticide (Gamma BHC, Malathion).

Insecticide (chlordane).
16 Termite
Not known. Wood boring nuisance.

17 Cyclops
(Thermocyclops nigeriana)
Guineaworm disease or Dracunculiasis.

18 Molluscus
(Bulinus Biomphalaria)
Schistosomiasis

19 Rats (Ratus ratus, Ratus norvegicus, Mastomys natalensis)
Plague, Leptospirosis, Lassa fever

Insecticide (chlordane).

Protect water supply, Health Education
Larvicide (Abate)

Molluscides, Health Education Proper disposal of excreta.

Rodenticides, Rat trapping. Better housing, sanitary disposal of refuse.
AIR POLLUTION

Air pollution, also referred to as atmospheric pollution, is the presence in the atmosphere of substance in the forms, concentration or for such duration that they cause nuisance to man, animals or plants.

The natural atmosphere or normal air contains 78% nitrogen, 21% oxygen, 0.03% carbon dioxide and the remaining include argon, neon, helium, crypton, methane and others. Air pollution is the result of the discharge into the atmosphere of excessive amount of normal air constituent or of foreign gases, vapours, droplets and particulates.

Sources of Air Pollution

Air pollution is caused by various activities of man. The sources of atmospheric pollution include:

(a) Combustion

The commonest pollutant of town air is from combustion, complete and incomplete, of fuels, especially coal and oil. Combustion can give rise to the following chemicals.

(i) carbon monoxide discharged from automobile exhausts and steel blast furnaces.
(ii) Carcinogenic hydrocarbons discharged from automobile exhausts.
(iii) Organic lead discharged from automobile exhausts. (Petrol contains additives – tetraethyl and tetramethyl lead and some of this is emitted as oxide during combustion of petrol).
(iv) Sulphur dioxide discharged from burning oils and coals containing sulphur compounds.
(v) Oxides of nitrogen, especially nitric oxide emitted in exhaust pipes when fuel is burnt under high pressure.
Specific Industrial Processes

These can give rise to:

(i) Hydrogen sulphide discharged from rayon industries, canning, dye making and oil refinery.
(ii) Hydrogen fluoride discharged from fertilizer, chemical and aluminium industries.
(iii) Carcinogenic hydrocarbons discharged from organic chemical industries.

Personal Habits

Personal habits, e.g. smoking can lead to discharge of carbon monoxide and hydrocarbons.

Nature

This can contribute to atmospheric pollution through:

(i) Pollen grains dust, mould spores, vegetable fibers, microorganisms.
(ii) Carbon monoxide discharged from coal mines, etc.

Health Effects of Air Pollution

The common diseases associated with air pollution include chronic bronchitis, asthma, emphysema, lung cancer. Heart diseases and irritation of the eyes are also aggravated by atmospheric pollution.

Control of Air Pollution

Atmospheric pollution cannot be completely prevented but can be controlled in the following ways:

(a) Site Selection

Careful planning of residential areas, industrial zones and highways to ensure that air pollution is minimised.
(b) **Process Redesign and Equipment Modification**

Use of tall chimneys; reduction at source through substitution of raw materials; wet methods to reduce dust; and use of electrostatic precipitators.

(c) **Legislation and Health Education**

Effective legislation backed up by health education.

(d) **Monitoring**

Regular monitoring of industrial gases, fumes and vapours.

**Greenhouse Effect and Ozone Layer**

The progressive warming-up of the earth’s surface due to blanketing effect of man-made carbon dioxide in the atmosphere is known as greenhouse effect.

The by product of manufacturing processes are released as flue gases into the atmosphere and they react with the ozone, forming other compounds. Consequently, there is a depletion of the ozone layer, i.e. the layer of upper atmosphere where ozone (a form of oxygen present in the atmosphere) is formed in quantity, protecting the earth from the sun’s ultraviolet rays and excessive heat.

**Other Hazards**

Elimination of other hazards, e.g. radiation, noise extreme temperature etc. is covered in Chapter Three.
Chapter Eighteen

PUBLIC HEALTH LEGISLATION

Public health is the practice of medicine concerned with groups or populations rather than with individual patients. It can be defined as "the science and the art of preventing disease, prolonging life and promoting physical health and efficiency through organised community efforts for the sanitation of environments, the control of communicable infections, the education of the individual in principles of personal hygiene, the organisation of medical and nursing services for the early diagnosis and preventive treatment of diseases, and the development of the social machinery which will ensure to every individual in the community a standard of living adequate for the maintenance of health". The major aim of public health is to modify man's environment and his own behaviour in order to promote health and change the natural history of disease.

The performance of public health activities is the statutory responsibility of health officers, and the laws and legislations governing these activities are known as the public health laws. Public health laws are aimed at keeping the environment clean through the abatement of nuisances or conditions in the environment that may be injurious to health. Public health laws can therefore be defined as a body of statutes, regulations or laws that have for their purposes the protection and promotion of individual and community health. They are also required in order to give legal authority and backing to health workers in the performance of their duties.

Public health laws in many African countries are similar to those of the developed countries from which they have their origin. The public health legislation in most English speaking countries was adopted from the British public health laws which was originally enacted in 1848, championed by Edwin Chadwick. In Nigeria, the early sanitary reforms were confined to Lagos. The first inspector of nuisance was appointed in 1877 and the first sanitary department was established in Lagos in 1897. In Lagos and later in other parts of
Nigeria, municipal boards were created and Medical Officers of Health (MOH) in government services assigned to the boards. Ordinances and rules governing the practice of public health activities were made and in some municipalities, sanitary departments had sanitary inspectors and other workers to carry out these activities under the supervision of a government Medical Officer who acted as the Medical Officer of Health.

The public health ordinance after necessary revisions formed the basis of the public health laws, now contained in the specific volumes of the laws of the various states of the country. The public health law which defines and regulates the practice of public health within each region, and now the state, is subject to revision by the Commissioner for Law Revision of each state.

Arrangements of the sections of the law may vary from state to state and from country to country but the provisions of the law are basically the same and include the following:

- Short title of the law; its application; senior health officers,
- duties of medical officers of health; nuisance which may be abated summarily; notice regarding abatement of nuisance; non-compliance with notice, court may make nuisance order; power to sell premises; right of entry; cost of execution relating to nuisance; fouling water; inspection of food exposed for sale to condemn unsound food; penalty for selling; search warrant; penalty for obstructing officer with search warrant; declaration of infected area and order for evacuation; spirit and wine and beer licences in area ordered to be evacuated; power to order post mortem examination; marking of premises where infectious disease has occurred; disinfection; power for health officer to order destruction of house, building or anything; destruction of animals, removal and detention of infected persons and suspects; isolation of contacts; notification of infectious disease; removal of bedding, and clothing, for disinfection; letting infected houses; acts tending to the spread of diseases; infected persons entering public conveyance without notice to the person in-charge;
disinfection of public conveyance; apprehension of persons in public streets suffering from infectious disease; appointment of house visitors; compensation time within which claims for compensation shall be made; restriction on civil proceeding; presumption of knowledge; power to make rules; penalty for obstructing execution of this law; obstruction of owner by occupier; general penalties; service of notices; occupier to give information; duties of police; sanitary inspectors to have power of constables; joinder of parties; burden of proof; protection of health officer.

Medical Officer of Health

A medical officer of health is a registered medical doctor with a postgraduate qualification in Public Health, but the public health law provides for the appointment of any medical officer to be the medical officer of health for any area, and in the absence of such appointment for any area, the medical officer of the area shall be the medical officer of health of the area.

It is the duty of every medical officer of health to inspect the areas to which he is appointed and to abate nuisances and otherwise to enforce the power vested in him relating to public health. The duties of the medical officer of health in addition include the following:

1. to inform himself about influences affecting injuriously the public health;
2. to investigate the causes, origin, and distribution of infectious disease;
3. keeping himself informed by inspection of conditions injurious to health;
4. advising his council or government on all matters affecting health in his area of jurisdiction;
5. upon the outbreak of an epidemic, visiting the place and inquiring into the cause and circumstances, and taking measures to prevent the spread of the disease;
6. direct the work of public health inspectors;
(7) where necessary dealing with unsound food;
(8) performing all duties laid down on him by laws and regulations of his council or government;
(9) dealing with offensive traders;
(10) making periodic reports;
(11) making weekly notification of communicable diseases, especially as directed by the World Health Organisation for scheduled diseases and by the state or national health authorities for others;
(12) making annual reports on all aspects of activities under his control.

In summary, the medical officer of health directs and co-ordinates all public health activities in the area and advises the authority on policies and matters relating to public health and environmental sanitation.

Health Officer
A health officer includes a medical officer of health, a sanitary superintendent, a sanitary inspector, (now environmental health officer), or other person acting under the authority, whether general or special, of the medical officer of health, and whether or not such sanitary inspector or other person is serving in the Ministry of Health or is in the service of a local government council. Every senior health officer shall be a medical officer of health, and whilst on duty in any place, shall have the power to direct sanitary work of such place and to give instructions to all sanitary inspectors, whether in the employment of the Government or not.

Nuisances
Section of the public health law, deals with the abatement of public health nuisances and penalties for non-compliance.

The following shall be deemed to be a nuisance:
(a) any premises in such condition as to be injurious to health;
(b) any premises which are so dark or so ill-ventilated or so damp or in such a condition of dilapidation, as to be dangerous or
prejudicial to the health of the persons living or employed therein;
(c) any premises which contain rat holes or rat runs or other similar holes or which are infested with rats or in which the ventilating openings are not protected by gratings in such manner as to exclude rats therefrom;
(d) any pool, ditch, gutter, watercourse, cesspool, drain, ashpit, refuse pit, lavatory, dustbin, washing place, well, water tank, latrine, sink, collection of sullage water, or other thing in such a state or condition as to be injurious to health;
(e) any animal or bird so kept as to be injurious to health of man or molesting to neighbours and any animal or bird suffering from a noxious or contagious disease;
(f) any hole or excavation, well, pond or quarry in or near any street which is or is likely to become dangerous to the public;
(g) any stable, cowhouse, pigsty, or other premises for the use of animals or birds which are in such a condition as to be injurious to the health of man or of such animals or birds;
(h) any noxious matter or water flowing or discharged from any premises into any public street or into any gutter or side channel of any street;
(i) any accumulation or deposit of rubbish of any kind whatever, or any decaying animal or refuse, manure, decayed or tainted food, or in any form whatever;
(j) any growth of weeds, cactus, long grass, reeds or wild bush of any kind which may be injurious to health, and any vegetable that of itself is dangerous to children or others either by its effluvia or through eating its leaves, seeds, fruits or flowers;
(k) any premises certificated by the health officer to be so overcrowded as to be injurious or dangerous to the health of the inmates;
(l) any premises on which servants or workmen are employed and suitable and adequate sanitary conveniences are not provided;
(m) any act, omission, place or thing which is or may be dangerous to life, or injurious to health or property;
(n) any plant or tree which may be specified by the Minister (Commissioner) by a notice published in state gazette on the
recommendation of a medical officer of health, as being favourable to the breeding of mosquitoes, found in any area which may be specified in the said notice. The law also provides the action to be taken on the abatement of nuisances, and penalty for noncompliance.

Infectious Diseases
The law provides for measures to be taken during an outbreak of an infectious disease and these include the declaration of infected area and order of evacuation of the whole or part of such area by the Minister (Commissioner); order of post-mortem examination of the body of the deceased person by the medical officer of health; order of disinfection of any building in which any case or suspected case of infectious disease has occurred and of any article or thing in such building; power of the medical officer of health to order destruction of house, building, animals, as well as removal and detention (e.g. in hospital) or isolation of infected persons or contacts.

For the notification of infectious disease, the public health law states that when an inmate of any house is suffering from an infectious disease, the head of the family and in his default the person in attendance on the patient and in default of such person the occupier or owner of the building shall as soon as he becomes aware that the person is suffering from an infectious disease, give notice thereof orally or in writing to the medical officer of health. It is incumbent also upon every medical practitioner consulted by or in attendance on any patient suffering from an infectious disease to give such notice.

The law further directs the measures to be taken by the medical officer of health upon notification of an infectious disease and stipulates the diseases to be declared as infectious diseases within the meaning of the public health law. The diseases include: Anthrax, cerebro-spinal meningitis, chicken pox, cholera, diphtheria, dysentery (amoebic, bacillary, unclassified), influenza, measles, plague, pneumonia (broncho, lobar, unclassified), poliomyelitis (acute, paralytic, non-paralytic), rabies (human), relapsing fever (Louse-borne, other), sleeping sickness, small pox, tetanus (neonatal),
other), tuberculosis, typhoid and paratyphoid fever, typhus (Louse borne, other), undulant fever, whooping cough, yellow fever

**Inspection for Food Exposed For Sale**

A health officer may, at all reasonable times inspect any food, eat, poultry, game, fish, vegetables, corn, bread, flour, or other provisions exposed for sale or deposited in any place for the purpose of sale or of preparation for sale and sold for human consumption, and if it appears to him to be unfit for human consumption or unwholesome, may condemn the same and order it to be destroyed or so disposed of as to prevent it from being used for human consumption.

Any person to whom food condemned under this section belongs or in whose possession or premises it was found shall be guilty of an offence and is liable on conviction to a fine or imprisonment.

In addition, rules are made under the subsidiary legislation of the public health law for slaughter houses and sale of meat. Such rules provide that no person shall slaughter any animal for the food of man except in a public slaughter house, in a licensed private slaughter-house, or under special licence; and except the animal has been examined by a health officer and is passed by him as fit for slaughter.

**Bye-Laws**

Subject to the provision of the public health law, the local governments may make bye-laws regarding the following:

- Sanitation of streets, buildings, dwelling houses, workplaces and places of public instruction, recreation or assembly.
- Removal and disposal of refuse, including night soil.
- Cleaning of verminous premises, persons and articles.
- Admission into any urban area of animals.
- Sanitary maintenance of all places where animals are kept or slaughtered.
- Enforcement of burial laws, including prohibiting and regulating burials in any place other than a burial ground declared under the Burial Law.
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Clostridium botulinum, 92, 93
Clostridium organisms, 92
Clostridium tetani, 92
Clostridium welshii, 92, 93
Coal dust, 9
Coal workers, 37, 46
Cockroaches, 101
Cold, 22-23
Coliform count, 69
Coliform organisms, 69
Combustion, 104
Concrete dust, 18
Contaminated food, 91
Contamination, 94
Cyclops, 101

De morbis artificum diatriba, 1
Dichloro-diphenyl-trichloroethylene (DDT), 2, 28
Disabled persons employment act, 3
Disability quota, 56
Disability, 61
Disease of miners, 1
Dispersion velocity, 22
Disque, 29
Dust, 27-28
Early evidence of diseases, 6
Elapids, 34
Electrostatic precipitators, 106
Elimination by substitution, 11
Entrepreneurs, 92
Environmental health, 65-67
Environmental sanitation, 66
Ergonomics, 3
External exposure, 16
Extrinsic allergic alveolitis, 40
Factories and Workshops Consolidation Acts (1901), 58
Factory Act (1833), 2, 58, 59
Factory inspectors, 2
Farmer's lung, 40
Father of occupational medicine, 1
Fecal oral diseases
See also Fecal-oral diseases, 80

Food
Distribution, 94
Processing, 94
Storage, 94
Food and Agricultural Organization (FAO), 96
Food hygiene, 91-96
Food handler, 91
Pathogenic micro-organism, 91
Food poisoning, 91
Food preservation, 95
Gamma rays, 15
Glossopharyngeal palsy, 34
Good houses, 87
Greenhouse effect, 106
Health education, 6
Health officer, 90
Heart attack, 5
Heat
Cramps, 22
Exhaustion, 22
Hyperpyrexia, 22
Stroke, 22
Syncope, 22
Helminths, 9
Helminthic infection, 33
Hepatitis, 11
Hepatitis B, 32
Herbicides, 29
House flies, 101
Human viruses, 80
Human immune globulin, 82
Hypertensive conditions, 20
Hypersensitivity pneumonitis, 86
Immunisation, 7
Impairment, 51
Industrial accidents, 11
Industrialisation (19th century), 2
Infectious diseases, 112

Falciparum, 101
Ingestion, 1
Injection, 11
Injuries from machines, 9
International Labour Organisation (ILO), 3
Insecticide poisoning, 100
Insecticides, 28, 97, 99, 100
Inspection of nuisance, 107
Irradiation, 15
Insulin, 1
John Holt, 3
Joint WHO/FAO Committee on food additives, 96
Large gas-tissue interface, 10
Larvicide, 97
Larvivorous fish, 98
Latrine, 75-76
buck, (conservancy), 76
composting (mulfurum), 76
pit, 75
septic tank and soakaway, 76
Drain, 10
Lead, 24-25
organic, 9, 24
poisoning, 24
Lead poisoning, 88
Legge, Thomas Morison, Sir, 2
Legge’s aphorisms, 2
Leptospira icterohaemorrhagiae, 31
Leukemia, 64
Lice, 101
Living organisms, 9
Locally applied exhaust ventilation, 12
Malignant pustule, 31
Maximum pail loaders (MPL) System, 83
Medical factory inspector, 2
Medical offices of health, 108, 119, 110
Medical social worker, 54
Mercury poisoning, 25
Microsporidia fumata, 40
Mites, 101
Milled dust, 37
Molluscus, 101
Mycobacterium, 93
Mycotoxins, 93
Natural ventilation, 12
Necropsy, 35
Neutrons, 15
Nigeria, 95, 99, 108
Federal Environmental Protection Agency (PEPA), 82
State Environmental Sanitation Authorities, 82
Nigerian Coal Corporation, 3
Nigerian Factory Act, 3
Nigerian Railway Corporation, 3
Noise, 9, 18-19, 106
induced deafness, 19
occupational, 19
Occupational acne, 42
Occupational asthma, 35
Occupational dermatitis, 41
Occupational disease, 11, 60
Occupational health, 35
Occupational health consultant, 2
Occupational health hazards, 22
Occupational health service, 8
Occupational injuries and hazards, 5
Occupational substances, 10
Occupational therapist, 54
Occupational therapy, 108
Organic chemicals, 99
Organophosphates, 29
Outbreak of an infectious disease, 112
Overcrowding, 88
Ozone layer, 106

117
Sunburn (erythema), 18
Sunburn poisoning, 11
Tall chimneys, 106
Termites, 101
Thaumatin, 7, 32
Thackrah, Charles Turner (1795-1833), 1
Thromboangiitis obliterans, 22
Tick, 101
Tonic spasms, 32
Toxins, 91-92
Toxins, 106
Tick-tick-fever, 101
Tuberculosis, 25
mycobacterium, 30
Ultra-violet, 18
Ultra-violet (UV) radiation, 18, 41
United African Company (UAC), 3
United Nations Conference on Human Settlement (1976), 68
United Nations Conference on Human Settlement (1977), 68
Urinary coproporphyrin, 25
Vector, 97-103
biological transmission, 97
Vector resistance, 101
Vehicle of transmission, 94
Venomous animals, 9
Venomous insects, 9
Vibration, 9, 19-20
whole-body, 19
localised, 19
Vibration-induced white finger (VWF), 20
Vibrio cholerae, 92
Vibrio haemolyticum, 92
Viper venom, 34
Vipers, 34
Water, 68-73
hard water, 69
treatment of, 71-73
Weld's disease, 31
Welder's flash, 18
Wells, 70
World Health Organisation, 190
Worker's Compensation Ordinance (1941), 58
X-rays, 15
Yellow phosphorus, 11
Zoonoses, 30